

Vol. XXI, No. 4.

PSYCHOLOGICAL REVIEW PUBLICATIONS

July, 1914

THE
Psychological Review

EDITED BY

JOHN B. WATSON, JOHNS HOPKINS UNIVERSITY

HOWARD C. WARREN, PRINCETON UNIVERSITY (*Index*)

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SHEPHERD I. FRANZ, GOVT. HOSP. FOR INSANE (*Bulletin*)

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CONTENTS

The After-Effects of Visual Motion: W. S. HUNTER, 245.

A Comparison of the Order of Merit Method and the Method of Paired Comparisons: MABEL BARRETT, 278.

The Systematic Observation of the Personality in Its Relation to the Hygiene of Mind: F. L. WELLS, 295.

PUBLISHED BI-MONTHLY BY

PSYCHOLOGICAL REVIEW COMPANY

41 NORTH QUEEN ST., LANCASTER, PA.

AND PRINCETON, N. J.

Entered as second-class matter July 13, 1897, at the post-office at Lancaster, Pa., under
Act of Congress of March 3, 1879.

Psychological Review Publications

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JOHN B. WATSON, JOHNS HOPKINS UNIVERSITY (*Review*)

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containing original contributions only, appears bimonthly, on the first of January, March, May, July, September, and November, the six numbers comprising a volume of about 480 pages.

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containing critical reviews, notices of books and articles, psychological news and notes, university notices, and announcements, appears the fifteenth of each month, the annual volume comprising about 480 pages. Special issues of the BULLETIN consist of general reviews of recent work in some department of psychology.

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*Annual Subscription to Review and Bulletin, \$5.00 (Canada, \$5.75,
Postal Union, \$5.30); Review, Bulletin, and Index, \$5.85
(Canada, \$6.00, Postal Union, \$6.15); Bulletin,
Alone, \$2.75 (Canada, \$2.85, Postal Union, \$2.95).*

*Current Numbers of the Review, 50c.; of the Bulletin, 25c. (special
issues 40c.); of the Index, \$1.*

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PSYCHOLOGICAL REVIEW COMPANY

Princeton, New Jersey

VOL. XXI. NO. 4

July, 1914

THE PSYCHOLOGICAL REVIEW

THE AFTER-EFFECT OF VISUAL MOTION

BY WALTER S. HUNTER

The University of Texas

INTRODUCTION

Problem and Point of View.—The past history of the present problem is long and complicated. I shall refer those who desire its presentation to the monographs of A. v. Szily¹ and A. Wohlgemuth.² There is one tendency which is present in practically all studies of visual after-movement. This is the persistent effort to reduce the causal factors to one only. I shall seek to remedy this defect of over-simplification by showing: (1) that there are at least three factors of great efficiency in the production of the illusion; and (2) that there are some cases where the after-effect takes place without all of the factors being active.

One of the three productive causes to which my experiments point is an eye-muscle strain due to the inhibited tendency of the eyes to follow moving lines. August Classen³ had in mind a similar factor, but his discussion was vitiated (?) by the assumption of feelings of innervation through which the subject became aware of the tendencies to eye-movement. Purkinje,⁴ Helmholtz,⁵ J. J. Hoppe,⁶ Stricker,⁷ *et al.*,

¹ Szily, A. v., 'Bewegungsnachbild und Bewegungskontrast,' *Ztsch. f. Psych. u. Physiol. d. Sinn.*, 1905, Bd. 38.

² Wohlgemuth, A., 'On the After-effect of Seen-Movement,' *Brit. J. Psych.*, Mon. Supp., 1911, Vol. 1, No. 1.

³ Classen, A., 'Ueber das Schlussverfahren des Sehaktes,' Rostock, 1863.

⁴ Purkinje, J., 'Beobachtungen und Versuche zur Physiol. der Sinne,' Bd. 2, S. 60, 1825.

⁵ Helmholtz, H. v., 'Handbuch der Physiol. Optik,' 2d ed., 1896, S. 764.

⁶ Hoppe, J. J., 'Die Scheinbewegungen,' Wurzburg, 1879.

⁷ Stricker, 'Ueber die Bewegungsvorstellung,' Wien, 1882.

have claimed that eye-movements of essentially a nystagmic character are set up and that these, persisting after the moving object had stopped, result in the illusion. The causal element which Classen and I defend is essentially different from this as will be seen later in the discussion. It is the same factor that Carr¹ and Adams² placed emphasis upon in their studies of the auto-kinetic illusion. The two other important elements in the production of visual after-movement are suggestion and the fading of after-images. The former of these, as here advocated, is more or less closely allied with the errors of judgment postulated by Zöllner³ and Budde⁴ and with the association factors claimed by Wundt.⁵

Subjects.—The data here presented were obtained from eight subjects. One was a professor of psychology. Two were instructors in English. Although untrained in psychology, they were excellent observers. Three were graduate fellows in psychology and one was an undergraduate who had had the conventional training course in experimental work. The remaining subject was the author of this paper.

Apparatus and Method.—The real⁶ movement was produced in one instance by rotating a Scripture drum upon which were black strips $\frac{1}{2}$ in. wide and white strips $\frac{3}{4}$ in. wide. The drum rotated about a horizontal axis and was driven by an electric motor. The rate of movement was controlled by a rheostat and a speed reducer. Unless otherwise stated the drum was maintained at a rate of one rotation in 3.3 secs. This was a medium rate and gave a clear perception of wavy real motion and an after-movement nearly equal in length to the period of stimulation. A screen of

¹ Carr, Harvey, 'The Auto-kinetic Sensation,' PSYCH. REV., Vol. 17, 1910.

² Adams, H. F., 'Auto-kinetic Sensations,' PSYCH. REV., Mon. Supp., Vol. 14, No. 2, 1912.

³ Zöllner, F., 'Ueber eine neue Art von Pseudoscopie und ihre Beziehung zu der von Plateau und Oppel beschriebenen Bewegungsphaenomenen,' *Poggendorf's Annalen*, Bd. 110, S. 500-23, 1860.

⁴ Budde, E., 'Ueber metakinetische Scheinbewegungen und ueber die Wahrnehmung von Bewegungen,' *Arch. f. Anat. u. Physiol.*, Dubois Reymond, S. 127, 1884.

⁵ Wundt, Wm., 'Physiol. Psychologie,' 6th ed., Bd. 2, pp. 614-24.

⁶ The *real* movement, which is the actual movement of the external object, is to be contrasted with the *after-movement*, which is the apparent movement of the external objects due to the previous stimulation of the eye by the real movement.

white cardboard with an aperture $4 \times 7\frac{1}{2}$ in. was placed between the rotating drum and the observer. The screen was surrounded by a black cloth which served further to conceal the apparatus from view. Unless otherwise stated the subject was seated about five feet from the screen in such a position that the moving black and white lines were the only parts of the apparatus visible behind the screen. No head-rest was used. In those experiments where it was desired merely to describe the after-movement, as opposed to those where the purpose was to control this movement, the subject was instructed: to hold his head erect; to relax his muscles; and not to strain his eyes any more than was absolutely necessary in order to hold his fixation constant. The usual fixation points were dots placed in the middles of the upper and lower boundaries of the screen aperture. Where another fixation or none at all was used, due mention is made of the fact. In other tests a black spiral upon a white disc was used. The fixation point was the center of the disc. The after-effects were observed either upon the disc itself or upon a printed sheet.

INTROSPECTIVE DESCRIPTION OF THE AFTER-MOVEMENT

Introspective characterizations of the after-effect of visual motion, when this motion is permitted to take its normal course without attempted interference by the observer, present data that are of considerable importance. I have brought together the following facts because of this and because of their bearing upon previous work in this field.

1. There are marked individual differences in the qualitative character of the after-effect. Many psychologically naïve subjects have been tested under conditions where the drum was rotated by hand rather than by the motor. The subjects interpreted the after-effect as a genuine rotation of the drum opposite in direction to the preceding movement. Some of the trained subjects also interpreted the after-movement as qualitatively similar to real rotation. Such an interpretation is at times replaced with all of the subjects by the feeling that the after-movement is a shadow movement,

unreal and ghostly yet nevertheless insistent and compelling. Some subjects took this view all of the time. One of the best trained observers persisted for several long periods in seeing the after-effect as a movement of something between himself and the drum which was known to be stationary. Depending upon the individual, then, and upon certain periods with the same individual, the after-movement may be interpreted as real, as a shadow or ghostlike movement on the drum itself, or as a movement of something between the observer and the drum,—this movement being contrary in direction to the real movement.

2. Various illusions of depth appear. None of the five subjects used in this test has failed to get this at some time during the experimentation. These illusions were much more prominent in work with the spiral. When rotated the spiral appeared to take the form of a cone with the point directed either away from or toward the subject. In the after-movement this third dimensional aspect was reversed. Where the after-movement was observed upon a printed sheet, it was this depth illusion and not the inward or outward flow which caught the subject's attention inevitably. In the case of the rotation of the parallel lines, the only illusion of depth which appeared was an occasional rapid receding of the drum area during the after-movement. This was not a rotation. The drum simply appeared to move farther away.

3. The after-movement does not always occur uniformly over the area which has previously been in motion. This is true whether the stationary area itself is observed or whether the after-effect is projected upon another surface. Later in this paper when treating of control, we shall have occasion to revert to this point. At present it must suffice to say that for some subjects the after-movement appears to break up into patches of movement about midway between its beginning and its ending. These patches of rest do not occur more frequently on the peripheral field than in central vision. Furthermore they do not always occur at the same relative position of the projection area. With one very excellent

subject, *e. g.*, the end of the after-movement has been most often described as a little patch of movement which varies in location from trial to trial. The direction of attention may be of importance here.

Another phenomenon deserves mention in this connection. All of the subjects found it difficult to say just when the after-effect stopped. There was a strong tendency for the movement to begin again when the subject offered the judgment 'stopped.'¹ Again—for some subjects more than for others—the after-movement had a tendency to be intermittent. It would appear, stop and reappear. The interval of rest was short. This paragraph should be read in the light of the control tests reported later in this paper.

4. I have sought for introspective characterizations of the nature of the stopping of the after-effect. Nothing has been secured that could be generalized. Some of the subjects regarded the stopping as a slowing up in the velocity of the movement. Others thought of it as a diminution in the intensity. The difficulty may well be entirely verbal. Either interpretation or both may be correct.

THEORIES OF EXPLANATION

In the consideration of a very old and much discussed problem, it is hardly necessary first to parade the experimental data and then to show their theoretical implications by repeating them in summary. In the present paper, I have chosen to group all of the observed facts accordingly as they support this or that explanatory rubric. Wohlgemuth suggests a division of the historical theories into physical, psychical and physiological. The classification has little intrinsic value, however, because the physical factors—eye-movements—reduce to physiological ones as do also the psychical ones where they are not claimed as overtly and explicitly conscious.

I think there can be little doubt any more that eye-

¹ A somewhat similar phenomenon has been described for the negative after-image of color by Thompson and Gordon (Thompson, Helen B., and Gordon, Kate, 'After-Images on the Peripheral Retina,' 1907, *PSYCH. REV.*, Vol. 14, p. 132).

movements are not a factor in the after-effects of visual motion. This theory—supported notably by Helmholtz—would have it that the motion seen sets up a nystagmus which, persisting after the motion ceases, is interpreted as a movement of the objects in the opposite direction. The essential objections to this theory, I conceive, to be the following: (1) Wherever the real motion is seen going in two or more opposite or divergent directions, no nystagmus which might hypothetically be aroused can account for the after-movement which opposes in direction the real movement. If a nystagmus can cause an apparent movement, this would be in one direction only. Such a factor cannot account for the after-effects from the rotation of a spiral, nor can it account for the after-movement which occurs when the lines on the rotating drum are viewed both on the drum and on a mirror held below the drum. (2) In the experiments where the fixation is maintained, there is no evidence of a nystagmus, and yet the after-movement certainly appears. If the subject fixates a dot at the middle of the top to the aperture behind which the drum is revolving, any marked shift from this fixation is indicated by the appearance of a negative after-image of the relatively dark moving area upon the opposite side of the aperture. My subjects were warned to watch for this, and the results indicate that with minor exceptions the fixations were maintained. Tests were also made in which the subject's eyeball was observed through a high power reading glass during and after the real movement. No nystagmus was in evidence. Barany's¹ observations support this. In speaking (S. 205) of the nystagmus produced by *fixating moving objects*, he says: "Einen Nachnystagmus der beim Wechsel von der Fixation der äusseren Gegenstände zur Fixation eines im Wagen, also in scheinbarer Ruhe befindlichen Gegenstandes auftreten könnte, habe ich nie beobachtet." (3) Our discussion of this topic may go farther. Could a nystagmus, *if present*, produce an apparent motion of objects in one definite direction? No satisfactory explanation of such an occurrence has ever come to my

¹ *Vide infra*, p. 252.

notice. The problem has far-reaching complications, an adequate consideration of which must be deferred to another time. It is necessary, however, to indicate some of the difficulties involved because of the past history of this factor with respect to visual after-movement. Nystagmus, interpreted as a mere oscillatory eye-movement, can hardly explain the phenomenon. Either the afferent impulses set up in the eye-muscles or the retinal displacements of stationary objects due to the persistent nystagmus should produce an oscillatory (after) movement of external objects rather than a movement in one direction. It is worthy of note, however, that cases are on record where such an alternation of opposed movements of external objects has resulted after rotation of the subject upon a revolving chair. (Barany, S. 221.) On the other hand, a theory which uses nystagmus in the usual sense of a slow follow movement with quick recovery has its difficulties also: (a) Let us consider the problem first from the side of the retinal displacements involved. Holt¹ has presented experiments indicating a central anesthesia during rapid eye-movements. Accepting these data, one is led to conclude as Holt does in his later study of visual dizziness² that during the rapid phase of the nystagmus there is no vision either before or after the objective movement has stopped. Any retinal factors producing the after-movement must then be induced during the slow phase of the nystagmus. Now while the eyes are following a slowly moving series of objects, there is no essential retinal displacement and therefore no fading after-image streaks will be left in the eye. If the nystagmus set up by the movement of objects were the same as that set up when the body is rotated and external objects are stationary, then when the movement of the objects ceased, the rapid and slow phases of the eye-movement would be reversed in direction. The retinal displacements of external objects during the slow phase of the persistent nystagmus would be opposed to the direction really taken by the seen after-movement, *i. e.*, they

¹ Holt, E. B., 'Eye-Movement and Central Anesthesia,' PSYCH. REV., Mon. Supp., Vol. 4, 1903.

² Holt, E. B., 'Vision During Dizziness,' Harvard Psych. Studies, Vol. 2, 1906.

would be in the same direction as the previous objective movement. If we do not assume that the nystagmus is reversed, then after the objective movement has ceased, the retinal displacements of stationary objects due to the slow phase will be in a direction suitable for the production of the after-movement actually seen. It is better to assume that the nystagmus is not reversed in as much as a reversed nystagmus seems to be correlated with a reversed vestibular stimulation. However the following reasons may be given why retinal displacements due to a non-reversed nystagmus could not condition the after-effect: (1) Where the nystagmic sweep of the eyes is wide, one should be able to duplicate the retinal displacements voluntarily. Such voluntarily initiated eye-movements do not result in the customary after-movement. This is taking for granted that a retinal displacement produced by a voluntary act has the same meaning as one produced by a reflex act. (2) If large movements cannot produce the required phenomenon, it seems unwarranted to assume that nystagmic movements of microscopic extent would do so by the retinal displacements involved. When Barany¹ claims that such minute movements may produce dizziness, he has simply stated the temporal coincidence of the two phenomena and has neither proved nor explained their causal connection. If we assume—as must be done—that the follow movements of the eyes do not keep up with the movement of the parallel lines when this proceeds at the rate used in the experiments of this paper, retinal displacements will result in fading after-images which are sufficient to produce an after-movement entirely independently of the nystagmus. (b) Let us consider the kinesthetic impulses set up by the nystagmus. Why should an oscillation of the impulse from the upper eye-muscles with the impulse from the lower eye-muscles produce an after-movement in one direction rather than two movements alternating in direction? Some one replies at once; "But, ah, the impulses arising from the two sets of muscles may vary in intensity and this may

¹ Barany, R., 'Untersuchungen über den vom Vestibularapparat des Ohres reflektorisch ausgelösten rythmischen Nystagmus und seine Begleiterscheinungen,' *Monatsschr. f. Ohrenheilk.*, Bd. 40, 1906, S. 214.

produce the after-movement." This is a valuable suggestion. However we must claim upon this basis that the less intense kinesthetic impulse (eye-muscle strain) is ignored and that the judgment is based upon the dominating strain. The work of Carr and Adams above referred to and my own experiments reported below show that the (after) movement occurs in the direction of the greatest strain. We are led to conclude, therefore, that the predominant strain is opposed to the direction of the real objective movement, *i. e.*, is opposed to the slow phase of the nystagmus. Now we are again in a position to maintain that the nystagmus *qua* nystagmus is irrelevant to the after-movement. It is the predominating eye-muscle strain that is important.

I referred above to the complicated nature of the present problem if it were followed out in all of its bearings. I cannot but mention one other point in this connection. Holt¹ in his study of ocular nystagmus was able to inhibit bodily dizziness by inhibiting the rapid phase of the nystagmus. This was accomplished by turning the eyes to an extreme position in the direction of the slow movement. Bárány in the work above mentioned (S. 224) was able to control both visual and bodily dizziness by the same method. (See my own control experiments below, p. 265.) In the light of data upon the present problem of visual after-movement, I think the explanation of this control lies in the fact that the strain in the new direction supported by association factors overcame the strain opposed in direction to the real movement. The result was an absence of movement. This point of view, I think, is preferable to Holt's more speculative theory of innervation processes. It also permits those who, like Professor Holt,² would find it hard to dispense with eye-movement sensations to keep that explanatory rubric.

There is another type of eye-movement which is not nystagmic, but which is always present in attempted fixations, *viz.*, the involuntary eye-movements of small extent and irregular direction. Theoretically it may be held that

¹ Holt, E. B., 'On Ocular Nystagmus and the Localization of Sensory Data during Dizziness,' PSYCH. REV., Vol. 16, pp. 390-1, 1909.

² *Ibid.*, p. 391.

these irregular eye-movements are interpreted as movements of the objects. A very similar doctrine has been advanced to account for the auto-kinetic sensation. But why should these irregular movements result in a fairly steady movement in one direction which is contrary to that of the stimulating movement? Such an hypothesis seems out of the question.¹

The explanatory factors of large significance are retinal changes, association factors and eye-muscle strains.

RETINAL FACTORS

If after watching a real movement for 20 secs., the subject turns his eyes toward a figured surface, he will see an after-movement which is limited in extent to an area corresponding to the retinal area stimulated by the original movement and which opposes in direction the original movement. This limitation of area is the great fact in support of an explanation of visual after-movement in terms of retinal factors as opposed to one in terms of the ocular muscles. In order to ascertain just how absolute this areal restriction of the after-effect was, I performed the following experiment:

1. One half of the aperture in front of the drum was covered with black paper. The subject was then instructed to fixate the upper dot² and to transfer the point of fixation to a dot on a printed sheet when the proper signal was given.

¹ For a discussion of this theory with reference to the autokinetic illusion see pp. 67-68, Carr, *op. cit.* I have not discussed the theory of special central movement processes in this paper, because the factors presented have seemed adequate to account for the phenomena and have also seemed less speculative. I find myself in agreement with much of the criticism which Henry J. Watt directs against Wohlgemuth's theory (Watt, Henry J., 'The Psychology of Visual Motion,' *Brit. Jr. Psych.*, 1913, Vol. 6, pt. 1).

² 'Upper dot' means the point of fixation in the middle of the upper side of the aperture. 'Lower dot' has a corresponding significance. I have made extensive tests upon 5 subjects in order to determine whether or not the direction up or down of the lines, or the fixation of the upper or lower dot had a peculiar effect upon the after-movement. A number of relations are here involved. If the upper dot is fixated and the drum moves downward, the lines not only go down, but they go away from the fixation point. If the lower dot is fixated, the lines still go downward, but they approach the fixation point. Similar relations hold for an upward rotation of the drum. I do not find that these changes have any effect upon the nature of the after-movement or upon the facility of controlling it.

These tests were carried out upon three subjects with uniform results from subject to subject. In as much as the screen surrounding the drum was white, it contrasted with the darkened area of the moving black lines so that under normal conditions the subject could project a negative after-image of the aperture upon the printed page. This negative after-image contained the after-movement within its boundaries. It had occurred to me that this restriction was due to suggestion from the size and form of the after-image. The nature of the surrounding objects had, in other words, inhibited the spread of the perception of motion. Placing the black paper over one half the aperture preserved the size and shape of the negative after-image and still prevented the stimulation of the retina by the movement over one half the area. Under such conditions the after-movement was still confined primarily to the area not covered by the black paper, but secondary phenomena appeared. The lines of print in the stationary area seemed to bend and be dragged into a participation with the moving part. Usually this was only evident at the boundary of the two areas, but at times the after-movement swept all of the area of the negative after-image along, even that in the part corresponding to an unstimulated retinal area. The explanation of this undoubtedly lies in the suggestion that if part of an unbroken line moves upwards the rest must do like wise. The participation of a factor of strain in the ocular muscles is also not to be over-looked.

I have not suggested what the nature of the retinal factor may be. The conventional theory at the present time is that of fading after-images. In the past, modified blood flow, displacement of retinal factors and other more or less mysterious factors have been proposed. Szily¹ and Schilder² describe a streaming phenomenon which occurs at right angles to the lines of the moving area. This has been pointed out before by Pierce³ and is mentioned by Ferree⁴ who,

¹ *Op. cit.*, S. 135-6.

² Schilder, Paul, 'Über auto-kinetische Empfindungen,' *Arch. f. d. ges. Psych.*, 1912, Bd. 25, S. 71-3.

³ Pierce, A. H., 'Studies in Space Perception,' N. Y., 1901, pp. 331-8.

⁴ Ferree, C. E., 'The Streaming Phenomenon,' *Amer. Jr. Psych.*, 1908, Vol. 19, p. 503.

however, holds that the phenomenon is not to be identified with that described by himself in his study of fluctuations of attention. The difficulty with an explanation in terms of the 'streaming phenomenon' lies in the limitation of the after-movement to a specific area. The objection to the other historical factors above mentioned lies in their mysteriousness. (This would be no real objection if facts could be adduced which demanded an explanation in retinal terms and which nevertheless were inconsistent with a theory of fading after-images.) The after-image theory does not encounter this difficulty. It is based upon the fact that after-images do fade in the direction of the moving stimulus. It assumes that this fading, although not directly perceived, leads to the interpretation that the stationary objects seen through the after-image flux are moving in the opposite direction. Wohlgemuth,¹ by way of maintaining his theory of a special central movement process, criticized the after-image theory as follows: By the fading of an after-image is to be understood a difference in the state of fatigue at two different parts of the retina. It is the recovery from fatigue which is designated by the term fading. Such a condition may well be postulated when a single stimulus passes across the retinal area. However, when a continuous succession of lines moves across the retina for the length of time used in securing after-movements, one part of the retinal area will be as fatigued as another. There can then be no fading and hence, on this theory, no after-movement. Wohlgemuth overlooks the fact that if such a uniform state of fatigue were secured, the subject would get a mixture of the black and white lines or at least a flicker and would not see a rotation or moving of the drum. It is customary to explain color mixture on this very basis of 'fatigue.' His own experiments prove that unless real movement is seen (*i. e.*, unless the rate of rotation is slower than that required for flicker) no after-effect can be obtained.² At this time the present writer is willing to view the retinal factors as most probably of an after-image nature. The terminology of the after-image theory is used in this

¹ *Op. cit.*, pp. 92-95.

² *Op. cit.*, p. 28.

paper, but the author is not convinced that some other so-called mysterious factors may not be very influential. In fact, he has experimental data which at present would appear to point to such factors. Further work is necessary before presenting this material. A brief statement, however, will be found on p. 275 of this paper.

In addition to the above experiment, the following have been performed and have yielded results supporting the theory of retinal causation.

1. If the subject observes the real movement of the drum with one eye and then watches the stationary drum or a printed sheet with the other *unstimulated* eye, the after-movement will take place, but more faintly than if the stimulated eye had itself seen the projection ground. When the after-movement is projected upon the printed sheet, *no after-image of the aperture* is present, and yet a slow drifting after-movement is seen. The fading of after-images will not account for the presence of the after-movement under these circumstances, but the *lack of body* in the after-effect may be accredited to the lack of the fading after-images in the unstimulated eye. Other instances will be noted later in this paper where the apparent movement takes place without the after-images, yet lacks the body of the normal after-movement.

This experiment was performed upon four subjects.

2. If black strips $\frac{1}{2}$ in. wide are pasted across the aperture so that they run obliquely from the upper left to lower right, a rotation of the drum will result in an apparent real movement of the black lines in an oblique direction. The after-effect is also in an oblique direction. It is the apparent direction of the real movement and not the actual direction which determines the after-movement. This is explicable on the basis of the after-image theory. If the retinal stimulation of lines moving vertically downwards plus association factors due to the oblique lines can produce the impression of oblique real movement, then the fading of after-images downwards plus the same association factors can produce the impression of after-movement upwards.

The after-effect of stroboscopic movement can be accounted for on this basis.

This experiment was performed upon two subjects.

3. Experimentation upon five subjects clearly establishes the following results: (a) If the subject observes the moving drum and then turns his eyes upon a printed page, the after-movement which is seen may often appear before the after-image of the aperture and will always disappear before the after-image. The after-movement reaches its maximal clearness before the after-image reaches a corresponding stage. (b) A faint after-movement may appear on the printed page when no after-image is secured. These two facts indicate a lower threshold for the after-movement than for the after-image. They are what one would expect from the after-image theory and the known facility in the apprehension of movement. Further one would expect the relative difference in fatigue, *i. e.*, the fading of the after-images, to be overcome before the absolute fatigue, *i. e.*, the existence of the after-image of the area as a whole. No exact quantitative determinations have been made.

4. A large series of tests were made on Plateau's spiral. Here we would expect the causal factor to be predominately retinal in as much as the movement went in all directions. Other factors may and do enter in as I shall indicate in the discussion of association and eye-muscle strain. In the present connection, I wish to stress one point merely, *viz.*, if the subject observes the rotating spiral with one eye and then turns his other unstimulated eye to a figured surface, *he does not see an after-movement*. The same *negative* result is secured if the subject maintains his fixation on the disc. This is a matter of great importance because of its fundamental bearing upon retinal factors and because it contradicts the observations of earlier writers, notably Szily. Four subjects in all were used and the greatest care taken to secure reliable data. The subjects—the present writer excepted—were ignorant of the theoretical bearing of this test. There was therefore no reason why factors of associative control should dominate here any more than in the similar monocular tests

with the rotating drum where positive results were obtained. Some of the subjects noted an uneasiness of the field of projection as soon as they turned the unstimulated eye in that direction. Some thought of this as an after-movement. When these same subjects, however, were familiarized with the 'uneasiness' of the projection field which is *normally* and inevitably incident to shifting fixation from one eye to the other, they one and all denied having seen an after-movement. Other subjects were familiarized with the apparent shifting of the characters on the projection field due to shifting fixation before the regular tests were started. These subjects never claimed to see an after-movement. Previous experience had acquainted them with the nature of the normal after-movement as seen with one eye. There is one other precaution which is of great importance here. Before the subject turns his unstimulated eye toward the projection field, he must be certain to cover the other eye. This is obviously fundamental. As trivial as it may seem, it was a source of error in several of the present tests. I attribute the after-movement of the spiral which other investigators have seen with an unstimulated eye to a neglect of the above factors. That they are easily overlooked, my own experience has taught me.

The negative results here obtained give emphatic support to the retinal character of the after-movement secured from Plateau's spiral. This is to be contrasted with the positive results secured from the rotating drum under the same conditions.

ASSOCIATION FACTORS

By association factors I mean interpretative processes. As such they are an integral part of the after-image theory; because it is not sufficient that the after-images fade, this fading must be interpreted as a movement of the objects seen through the flux. This association factor seems to be a lineal descendent of the theories that explained the after-effect of visual motion in purely psychical terms. The representatives here are Budde, Lotze¹ and Zöllner. All hold in common to

¹ Lotze, R. H., 'Medizinische Psychologie,' Leipzig, 1852, S. 443-4.

the assumption that the after-effect is due to a predisposition of the mind to judge in a certain manner. Those who hold to a special movement center (*e. g.*, Exner, Szily and Wohlgemuth) are stating in neurological terms this persistent tendency to a certain interpretation. Why is the observer impelled to interpret stationary objects as moving in the opposite direction to the previously seen real movement? Lotze says it is because the mind has grown accustomed to seeing movement so that the habit now persists—a case purely of contrast. Wohlgemuth says the after-effect occurs because the direction of fatigue has been changed in certain central summation cells. One may be viewed as the neural counterpart of the other, because even a 'psychical' explanation must be neurologically conditioned. Wohlgemuth might claim that there was no conscious representative of the central movement processes *per se*,—but then Lotze does not, I think, maintain that the 'tendency' is overtly conscious. In either case it is only the end process, the after-movement, which is detected in consciousness.

My criticism of the after-image theory and the share that it must allot to associative or interpretative factors is that it does not go far enough. These latter factors may even *control* and *overcome* the former and any other causal factors that may be effective in the production of the after-effect. The most important facts in the present paper were discovered as a result of training the subject to *control the after-movement*. Strange as it may seem, no such tests have been brought to light in the literature of the subject. Experiments have been made to discover whether or not the after-movement would take place when the subject's attention was distracted, but that is as far as such tests have extended.

The following statements will indicate the essential facts bearing upon association factors:

1. *Voluntary Control of the After-movement*.—Five subjects were used in this test with from 50–200 trials per individual. Control of the present illusion is not so much a matter of long training as it is that of catching the proper method. The illusion is very insistent. One would expect this if retinal

factors are involved. After the first two or three trials when the subjects all had confessed their failure, the experimenter instructed them as follows: "You know the lines are not really moving. Why let yourself be deluded into the contrary belief? Set all of your will power against the after-movement. Notice that the lines next the fixation point never get farther away (or nearer)." These instructions, within 5 trials at least, brought success in this sense, the lines would stop and then flow, stop again and then flow on. The subject was then requested to stop the *two lines nearest the fixation point* and so to attempt gradually to extend his control over the whole area. In doing this great care must be used to maintain fixation and merely to attend to the lines in peripheral vision. Great stress was laid upon this point and the subjects exerted themselves to the utmost. If the fixation had shifted there would be excellent grounds for attributing this supposed control of the striped area nearest the fixation point to the fact that the area now fell upon a part of the retina which had been unstimulated by the real movement. Occasionally such shifts did occur. They could always be detected, however, by the appearance of a bright after-image of the aperture on the opposite side of the screen from the fixation. The subjects were instructed in this method of detecting a change of fixation. The observed area was small enough and distant enough to render such observation feasible.

By means of the simple method outlined above, all of the subjects were enabled to control from $\frac{1}{4}$ to $\frac{1}{2}$ of the drum area. This control tended to be intermittent at first, but became steady and continuous as the tests continued. The remaining $\frac{3}{4}$ or $\frac{1}{2}$ of the area was involved in the normal after-movement during the control. No subject succeeded in stopping the entire after-effect by the method here described. What control there was, I am inclined to attribute to association factors. Another possibility will present itself in the discussion of eye-muscle strain.

In order to secure a better control, the subjects were instructed to clench their fists and jaws and to secure muscu-

lar rigidity in general. Their heads were held upright during this procedure, so that there was no conscious eye-muscle strain. Under these conditions some of the subjects were able to extend the area controlled even to frequent complete success. This may also be termed control by association factors. General muscular rigidity or the feeling of bodily inertia apparently aided in bringing about the interpretation that some or all of the lines were really not moving at all.

The evidence for the effective presence of general association factors is not confined to experiments on control and to the general statement that fading after-images (or other retinal processes) must be interpreted. The following experiment and observations must also be considered:

2. The subjects (four in number) were each requested to fixate one of the dots during the real movement and then, when the drum was stopped, to turn their eyes to the central stationary line. This resulted in seeing a portion of the drum with a part of the retina previously unstimulated by the movement. One subject saw this portion of the drum (*i. e.*, the upper part, if the original fixation had been the upper dot) as stationary. The rest of the drum gave the characteristic after-movement. All of the other subjects saw two movements on the drum. These two either met or parted in the middle of the drum, *i. e.*, at the point of fixation, depending upon whether the real movement had been up or down respectively. One of these movements can be accounted for by the after-image theory; but the other opposing movement which corresponded to a part of the retina unstimulated by the original real movement must be explained in terms of association factors somewhat as follows: Where object *A* really moves towards *B* (really stationary) under conditions which do not favor a comparison with other objects in the environment, the phenomenon may be interpreted in three ways: (*a*) either *B* is stationary and *A* moves towards (or away from) it; or *A* is stationary and *B* moves with respect to it; or (*c*) both *A* and *B* move. It is this latter interpretation which was prevalent with the subjects of the present test. The theory of fading after-

images cannot explain this. Great stress should be laid upon the *narrowing of the field of attention* which introspection reveals as occurring with a steady observation of moving lines and spirals. The subjects become so engrossed with the mere movement or with the depth illusions involved that all else drops to a very low attention level. It is this fact which gives so much free play to factors of association and eye-muscle strain as we shall see below. Under every day conditions, the constant shifting of the visual field and of the interests tends to obliterate or check up the illusory data. But where conditions all favor the perception of motion, motion is readily perceived. The movements of the eyes in every day life may quite readily be seen to carry along a swinging and swaying of the objects of the visual world. In many ways these are trite psychological sayings. They deserve restatement here because of the light they throw upon the possibility of associative factors being instrumental in the perception of visual after-motion.

3. There are two other observations made by the subjects during the course of the experimentation upon the rotating drum which have a direct bearing upon the present topic. (a) During the real movement as well as during the after-effect, the sides of the white screen surrounding the drum may seem to move in the opposite direction to the drum. This is a phenomenon which receives very little attention in the literature. (b) Particularly during the after-movement, if the fixation is the lower dot and the after-movement is downwards, the lower part of the screen has been seen to move steadily upwards at a considerable velocity. Some subjects have voluntarily commented upon these two happenings. Others have had to have their attention called to the possibilities. Usually the attention is so engrossed with the drum that any movements of the screen are ignored or unseen. (c) The stationary drum was often declared to be moving slowly. This declaration was never made unless the subject was familiar with the normal after-movement. This steady flow of the lines or their persistent tendency to flow is possibly to be explained largely in terms of association

factors. The phenomena of retinal irradiation and of various entoptic activities would not account for direction of movement, although they remain as a possible material for interpretation in terms of directive movement. Eye-muscle strains aroused by expectation may be the cause here as they are in other phenomena noted below.

EYE-MUSCLE STRAIN

In 1863 August Classen published an article, 'Ueber das Schlussverfahren des Sehaktes,' Rostock, wherein he accounted for the after-effect of visual motion through feelings of innervation. I have not had direct access to this paper. It is not cited by Szily and many other writers. For clearness and completeness, I reproduce Wohlgemuth's summary. "He [Classen] denies that the phenomenon is due to involuntary eye movements since he could not discover such by objective observation. He agrees with J. J. Oppel that it is not due to after-images but denies that it is caused by a process in the brain. He looks for an explanation of the phenomenon in the reflex tendency of the eyes to follow any movement and the innervation of the antagonistic eye-muscles to resist it. When the eye is turned to a stationary object, the increased innervation continues but, being no longer adequate to the visual experience, produces visual vertigo (Gesichtschwindel). As in paralysis of an eye-muscle, the vertigo is not caused by the feeling of tension but by the feeling of impulse to contraction, *i. e.*, the sense of innervation."¹ Heuse² criticized this theory because if the eyes are strained in one direction no after-movement is produced in the direction indicated by the theory. Wohlgemuth² has two objections to the theory: (1) It involves the dubious doctrine of feelings of innervation. (2) It will not account for the after-effects of motions that proceed in many simultaneous directions.

The objection by Heuse, I shall meet with experimental data bearing directly upon the question. With the first of

¹ Wohlgemuth, *op. cit.*, p. 6.

² Wohlgemuth, *op. cit.*, p. 96.

Wohlgemuth's criticisms, I am in hearty accord. It is undoubtedly due to this factor of feelings of innervation as well as to the innate attractiveness of the opposing theories of after-images and special movement centers that Classen's mode of attack has been so long ignored. Wohlgemuth's second criticism betrays the persistent fallacy of investigators in this field. Why should a factor in order to be rated as causal need to be present in all types of after-movement? Eye-muscle strain may well be the dominant factor when the illusion of after-movement is obtained under one set of conditions and some other factor may be dominant under other conditions. I agree with the critic in thinking that any such factor as Classen suggests must have a very slight influence in such cases as those indicated. Indeed the foregoing pages have contained data on the rotating spiral conclusively proving this point. This does not mean, however, that under other conditions eye-muscle strain may not be an important causal factor. (1) I think there can be little doubt that eye-muscle strain reported in the form of kinesthetic sensory impulses can occasion the perception of motion. The researches of Carr and Adams upon the auto-kinetic illusion clearly indicate this. Furthermore, (2) we have the general fact that in all cases, of simple real movement, such as that of parallel black lines, the strain produced in the eye-muscles due to the inhibited reflex tendency to follow moving lines would be in the *proper direction* to explain the resulting after-movement. These two points are important in giving a theoretical background of probability to the following experiments and observations.

1. The importance of eye-muscle strain was first noted in the present investigation through attempts at controlling the after-effect. The subject was instructed to fixate the upper dot and bend his head forward in such a manner as to cause a severe strain upon the upper eye-muscles. He was told to control the after-movement if possible. The vision of the drum was unobscured by the eye-brows. The drum was now rotated downward for 20 secs. Two general types of results were obtained: (1) The subject saw no after-movement.

(2) An after-movement was seen, but its duration was very brief. It was in a normal direction, *i. e.*, opposed to the real movement. The duration of the after-movement under conditions of normal fixation and a 20 secs. exposure varied between the extremes of 15 and 20 secs. for all of the five subjects tested. Under the conditions of this experiment, the duration of the after-effect, when present, varied between 2 and 8 secs. with an approximate average of 6. Of the various subjects, one always secured a short after-movement. Three others secured an occasional after-movement. Another subject never reported one. The following report of eight tests made upon a member of the second class will illustrate this point. No reliable time measurements could be made.

STRAINED FIXATION OF UPPER DOT. REAL MOVEMENT UP

- Test 1. Didn't see much movement to stop.
- Test 2. Ditto.
- Test 3. Didn't see any movement. Sure of fixation.
- Test 4. Ditto.
- Test 5. Everything stopped instantly with the real movement.
- Test 6. Ditto.
- Test 7. Ditto, very little effort.
- Test 8. Ditto. Slight sensation of screen and himself going upwards.

The introspection in the last tests is worthy of notice. Not only was the normal after-movement absent, but the whole apparatus and he himself as well tended to float upwards. This occurred rarely with *P*, but subject *T* reported the sensation continually during this type of test. This is the conventional auto-kinetic illusion, with the exception that it occurs in daylight illumination and for complex objects. I refer the inability of surrounding objects to check the illusion in this instance to the intense concentration of attention.

The same control of the after-movement was obtained where the lower dot was fixated with a strain on the upper eye-muscles and the drum rotated upwards. Whenever an after-effect was present, it went downwards for a brief interval. Where the drum rotated downwards and the upper eye-muscles were strained during the fixation, control was still possible although it was more difficult when judged by the number of times that short after-movements appeared.

Two subjects under conditions of eye-muscle strain were unable to secure an after-movement when they tried to do so after they had been trained to control the after-effect by this method. Their failure is to be accounted for undoubtedly upon the basis of this habit.

Two explanatory factors are necessary in order to account for the results of this experiment: association and eye-muscle strain. The main point of the control was to secure conditions under which the dominating strains would either blot out or over-balance any strains due to inhibited eye-movements. This can readily be seen to have succeeded save where the strain was in the same direction as that which we sought to counterbalance. Here the explanation lies in interpretative factors due to the *Aufgabe* and to the fact that a mere bulk or mass of strains may be unfavorable to the after-movement by providing explicit standards of reference which serve to check up the (illusory) interpretation of eye-muscle strain. It is not surprising that short after-effects occurred when it is borne in mind that fading after-images (or other retinal factors) were present. The astonishing fact is the control, *i. e.*, the absence, either total or nearly so, of the after-effect. I was inclined at first to interpret the short after-effects here in evidence as due to retinal factors and to conclude that the period from 6 secs. to 15 or 20 secs. was in general represented by the eye-muscle strain factor. Such an explanation, however, is not valid. The experiment on the spiral above cited which indicated that strains are negligible in that type of after-movement revealed also the fact that the duration of the after-movement of the spiral was the same as that for the rotating drum. It is impossible, then, within the bounds of the present data to sever temporally the effects of retinal and muscular factors. It seems quite probable that the effective phase of the one may, under the present conditions, be confined within the same temporal limits as the other. One would not appreciably outlast the other, but both together would give a more intense after-effect than either alone.

2. If the subject observes the rotating drum with one eye

and then closes that eye and observes the stationary drum with the other eye, he secures an after-movement which is the same as that normally secured by the stimulated eye save that it is fainter and of shorter duration. This is in harmony with the results obtained by other investigators. This faintness may be described as a 'lack of body.' Three subjects were used in this test. All were able to secure the after-movement with the unstimulated eye. They varied only in their experience of the duration of the after-movement. If the subject turned his unstimulated eye toward a printed sheet, he saw the after-effect there. It was observed in the vicinity of the point of fixation, but *no after-image of the aperture was secured*. The subjects were tested in order to ascertain whether they could secure an after-image in the unstimulated eye from a square of black paper. The results were always and absolutely negative. The present phenomenon then cannot be explained upon the basis of fading after-images. Historically the case has been used as an argument in favor of central causation. Such a theory is inadequate and unnecessary. If the contrary were true, the spiral should have given an after-movement in the unstimulated eye. The after-movement seen by the unstimulated eye on the drum may be explained in terms of eye-muscle strain. Fatigue of the muscles of one eye is paralleled by fatigue of those of the other eye. In the case of the rotating spiral where the phenomenon is one of fading after-images, one would not expect an after-movement from an unstimulated eye. With the rotating drum, the real movement is all in one direction so that an asymmetrical eye-muscle strain is possible. In as much as the after-movement from the unstimulated eye is weaker than that from the stimulated eye, the present case offers further confirmation of the causal effectiveness of retinal factors.

There are certain other historical phenomena which have been interpreted as giving a basis for a central theory of causation. These, however, permit of a statement in terms of the harmonious action of the eye-muscles. I quote the following from Szily:

“Als schräges Liniensystem dient der zu meinem Kontrastversuch (S. 123) benützte gestreifte Kattun, mit welchem man den daselbst ebenfalls erwähnten grossem Rahmen in der gewünschten Richtung überspannt. Dieses beliebig schräge Liniensystem wird hinter einem Schirm mit einem Ausschnitt von 20 cm. Durchmesser langsam in horizontaler Richtung vorbeigeschoben, indem der Beobachter mit einem horizontal umkehrenden Prisma vor einem Auge eine genau in der Mitte des Ausschnittes angebrachte Fixationsmarke zu binokularer Vereinigung bringt, wodurch auch die beiden bewegten Flächenbilder genau übereinander gebracht werden (26). (Ich ziehe diese Anordnung der Benützung einer schräg linierten Kymiongraphion-trommel vor, weil bei dieser, infolge der Konvexität der Fläche, die äussersten seitlichen Teile derselben keine ganz entsprechende binokulare Deckung erfahren wurden.) Auf die angegebene Art erhalten die beiden Augen gleichzeitig symmetrisch entgegengesetzte schräge Bewegungseindrücke, bei welchen sich die Erscheinungen des binokularen Wettstreites in ausgiebigem Masse geltend machen. Wendet man nach genügender Einwirkung die Augen plötzlich nach dem Projektionsgrund, so gewahrt man ein durchaus *vertikales* Bewegungsnachbild (Bewegungsrichtung nach *oben*, wenn die Verschiebung der Tafel in die Richtung der Neigung der Konturen stattgefunden hat; nach unten im entgegengesetzten Falle). Schliesst man hingegen sofort nach Empfang des objectiven Eindruckes plötzlich ein Auge, so verläuft das nun wahrgenommene Nachbild, entsprechend dem diesem Auge allein zuteil gewordenen Eindruck, *schräg*, jedoch zweifellos *nicht in dem Masse schräg*, als wenn der das Nachbild auslösende Eindruck während einer gleichen Zeitdauer dem einen Auge allein, ohne gleichzeitige symmetrisch entgegengesetzte Erregung des zweiten zugeführt wird.”¹

This phenomenon described by Szily is what would be expected if eye-muscle strain were the important factor. The tendency is for the eyes to move in divergent directions. This results for the left eye, e. g., in a strain which is not

¹ *Op. cit.*, S. 129-130.

directly opposed to the oblique movement seen by that eye, but is modified toward the vertical by the strain on the other eye. I have not repeated this experiment.

Szily also reports an experiment upon rotating spirals.¹ The spirals were opposed in direction of movement. One was viewed by one eye, and the other by the other eye. No after-movement resulted.

I have repeated this experiment carefully upon myself. Positive results were secured, *i. e.*, the superposition of the spirals did not destroy the after-movement. Two spirals (black upon white discs) which were wound in contrary directions were placed upon a color mixer having two spindles side by side. Both spindles were run from the same belt by a motor. A glass prism was used to superimpose one disc upon the other. The subject sat at an approximate distance of $1\frac{1}{2}$ feet. This enabled him to secure a clear image of each disc. Tests were made in which the outward turning disc was superimposed by the right eye upon the inward turning disc seen by the left eye. Tests were also made in which the discs were interchanged, and also some in which the prism was held before the left eye. These varying conditions had no detectable effects upon the results. The interval of exposure was 20 secs. (time counted with a metronome). In one series a period of 40 secs. was used. The experimenter found no difficulty in superimposing the discs by keeping the center nuts co-incident.

During the real movement, the subject never felt that he secured a mixture of the movements. Retinal rivalry was present. The after-effect was projected upon a large dull white sheet of paper covered with printed characters and distant 5 feet from the observer.

Results.—An after-movement was present in 95 per cent. of the trials. It was practically always an outward movement. A very few times, it could only be characterized as movement. Retinal rivalry was not noticed. The after-effect was fainter than if both eyes had seen the same real movement. The after-movement present was as positive

¹ *Op. cit.*, S. 128-129.

and as genuine as an after-movement could be. It was not a mere uneasiness such as is normally incident to a shift of fixation. Its duration averaged around 6 secs. or more. The domination of the outward after-movement is probably based upon a greater facility for catching the attention. This has not been thoroughly tested, but scattered results would suggest its truth.

The results here secured are in harmony with the theories of retinal and associative causation. Where corresponding retinal points are stimulated by fading after-images in such a manner as to elicit contrary judgments, one can expect either rivalry or a domination of one judgment. It is indeed conceivable that the two retinal processes should so nearly balance, *i. e.*, be so nearly of the same intensity, as not to lead to a judgment of movement at all. The case here is different from that of a so-called binocular mixture of color. There one deals with a central fusion of sensory qualities. Here the process is essentially judgmental in that it is an interpretation of one phenomenon (fading after-images) as a movement of another (stationary objects) totally irrespective of sensory qualities. (Obviously I am not holding that this interpretation takes place as a process overtly conscious.) If there is not enough of the fading after-images in one direction dominant—due either to different relative intensities or to varying powers of attracting attention—the judgment or interpretation of movement will not be aroused. Central processes are indeed involved, but not in the sense of special movement centers.

One other case may be drawn from the literature. Wohlgemuth¹ describes tests in which by successive real movements of opposite sign, he so fatigued the subject that no after-movement, or only a faint one, resulted. When the real movement was at right angles to the ones for which fatigue had been set up, the after-movement was unaffected. Here again one would find difficulty in accounting for the phenomenon by the after-image theory. It is intelligible, if eye-muscle strain is a causal factor. One would not expect a

¹ *Op. cit.*, pp. 78-80.

fatigue of the superior and inferior eye-muscles to fatigue the internal and external ones. This is assuming the validity of Wohlgemuth's observations.

3. The *stationary* drum may be made to appear to rotate by straining suitable eye-muscles. In this experiment the seven subjects used were requested to observe one of the fixation points and to describe any movement seen. Four eye positions were used: (a) with head tilted back, giving strain on the lower eye-muscles; (b) with head bent forward, but with eyes turned so as to look toward the side, giving strain upwards upon lateral muscles (right and left sides were used indifferently); (c) with head bent forward, giving strain upon the upper muscles; (d) with head bent back, but with eyes turned to the side, giving strain downwards upon lateral muscles. The results were consistent for all subjects. The lines upon the drum drifted in the direction of the eye-strain either upwards or downwards within a few seconds after the fixations were secured. The best results, *i. e.*, the clearest 'after-movements,' were obtained from the strain of the lateral muscles. The lower muscles were next; and the upper muscles, last in point of efficiency. The lesser efficiency of these two classes lay in the irregularity of the appearance of the movement and not in the velocity and clearness of the movement when it did appear. This inefficiency is not surprising when it is remembered that the production of apparent movement by eye-muscle strain is based upon interpretations of the strains under unusual conditions. The forward bending of the head with the eyes looking straight in front is a far more usual type of eye position than the others, *i. e.*, it offers more secondary cues for the counterbalancing of the apparent movement. After the subjects had been tested by these methods, it was not necessary to maintain extreme peripheral fixation in order to secure the 'after-movement.' The effect could be produced by slight inclinations of the eyes in the above mentioned directions.

In the light of the discussion earlier in the paper, it is more reasonable to interpret the present results on the basis of eye-muscle strain than upon the basis of any slight nystag-

mus present in cases of peripheral fixation. The results with slight strains are also antagonistic to such an interpretation. The results of this experiment refute the objection attributed above to Heuse that eye-muscle strains could not produce movement of a stationary drum. (See p. 264 above.)

4. The problem here was to determine whether eye movements during the observation of the real movement would inhibit the after-effect. In the literature, there is much dispute whether or not eye movements are favorable to the perception of the after-effect. J. J. Oppel thought fixation favorable. He is followed in this by Szily, Exner, Wohlgemuth and others. Helmholtz maintains that where the fixation is rigid no after-movement takes place. He accounts for Oppel's results on the basis of poor fixation. Both of these observations can be understood from the point of view of the present paper. A constant fixation, if rigidly maintained, is a most favorable condition for the appearance of association factors which tend to control the after-movement. Eye movements, if rapid, may accomplish two things: (1) They may prevent the appearance of an eye-muscle strain in any one direction. (2) They may weaken the after-image by not subjecting the same retinal area to constant stimulation. In either case the after-effect may be absent or extremely faint. In the test to be cited immediately, the latter factor was only faintly if at all operative. However the tendency to associative control must be recognized as well as the absence of eye-muscle strain.

In the present experiment, the three subjects used were instructed to move their eyes *rapidly* over the *central* area of the moving drum. They all accompanied this with head movements and general muscular activity. At the end of 20 secs., the drum was stopped and the subject either fixated the upper dot or turned his eyes to a printed page. In neither case did an after-movement occur, although with a steady fixation and 5 secs. rotation of the drum, a good but short after-movement is seen. The subject who was most thoroughly tested was able to secure a faint after-image of the aperture within the 20 secs. of real movement, but no after-

movement appeared. This is of particular interest in view of the results above given which indicate that the after-movement normally has a lower threshold than the after-image.

5. This is another experiment in which I have tried to analyze out the influence of the factor of eye-muscle strain. A mirror was placed below the rotating drum in such a position that the subject could not see between the two.¹ A tack or other small object was placed at the boundary between drum and mirror for a fixation point. Whenever the drum rotates, the reflection in the mirror moves in the opposite direction. Three subjects were used. During the observations the eyes were from one to two feet from the fixation point.

The normal after-movement secured moved in two different directions corresponding but opposed to the directions of the real movement. Two methods of control were used, strain on the upper eye-muscles and mere voluntary effort without conscious strain. All three subjects were able to secure a partial control over a part of one after-movement by this latter method. In other words, part of the drum area or part of the mirror area would be seen as stationary, while the rest moved in the accustomed manner. At some time, each subject was capable of stopping one movement entirely. This control was apt to be brief and to be followed by the regular phenomenon. Quite as frequently, the subject would set up an alternation of after-effects, *i. e.*, a movement would be seen on the drum and then one on the mirror, etc. The subjects felt that they could see the after-movement in either locality as they chose. One subject was able to control all after-movement at all times. Indeed at the beginning of the tests, it was impossible for him to secure any after-effects at all. In as much as he was the most practised observer of all, this can hardly be attributed to poor introspection. It must rather be put to the credit of associative control.

¹ See Julius Hoppe, 'Studie zur Erklärung gewisser Scheinbewegungen,' 1894, *Ztsch. f. Psych. u. Physiol.*, Bd. 7, S. 31.

When control was attempted with eye-muscle strain, the same general phenomena occurred which have just been described. The following qualification, however, should be made: It was a rare occurrence when an after-movement appeared in a direction opposed to the strain (the upper eye-muscles alone were used). It is possible that this was due to suggestion independently of the strains.

6. Two general observations may be cited here in support of the presence of a factor of eye-muscle strain. (1) At intervals with two subjects the entire apparatus seemed to float upwards along with the after-movement. At such a time there was no apparent movement of the drum within the general movement of the whole. There was no doubt in the subject's mind concerning this occurrence. It was a clear and irresistible feeling. This general movement is clearly in a class with the auto-kinetic illusion. That it should take place so clearly in daylight illumination is not surprising. The conditions of observation favor extreme concentration of attention which minimizes any corrective influence of surrounding objects. (2) The after-effect of motion is determined by the apparent direction of the real movement. This has already been discussed (see above, p. 257) in relation to the after-image theory. It remains to point out here that eye-muscle strains may also be regarded as a possible factor. The eyes tend to follow the real motion in the direction that it *seems* to be taking and not in the direction which it really has objectively. Introspection verifies this. The resulting strain will, therefore, be opposed to this apparent movement and will aid in the production of the after-effect.

7. On page 257 of this paper, I spoke of having data which suggested the possible influence of some so-called 'mysterious factors' in the production of the after-movement. Those data were obtained from a preliminary study of the visual after-effects to be derived from the use of a stimulus which occupied most or all of the visual field. A full treatment of this problem is reserved for another paper. At this time a few facts only need be given. Szily¹ found that visual

¹ *Op. cit.*, S. 122-126.

movement of large extent was followed by an after-movement *in the same direction*. His method was to project the after-movement upon objects in the room. Wohlgemuth¹ attempted to repeat the test, but did not project the after-movement upon neighboring objects. He stopped the moving curtain and watched for the after-effect upon this. His results were almost entirely negative, *i. e.*, he and his observers got either no after-movement at all or at times a slight one in the normal direction.

In performing this experiment, I have used a large dark blue and white striped cloth (stripes $\frac{1}{8}$ in. wide) looped about two rollers. The total area exposed was 6 ft. long by 4 ft. high. Rotation was produced by a motor. Most of the observations have been made upon the writer himself. They have been checked up, however, by data from two other observers. At present the results are incomplete. Of one fact, however, there can be no doubt whatsoever, *viz.*, after a 20-30 sec. stimulation, if the eyes are turned to the wall of the room, this seems to move in the same direction as the rotating lines. Particularly when the after-movement has been projected upon a printed sheet, I have gotten another simultaneous phenomenon. The point of fixation has moved in a direction opposite to the real movement. It is as though a shadow movement were passing in the same direction as the real movement and were causing the interpretation of an oppositely directed movement in the fixation point. Often this latter movement is late in making its appearance. In any case, the after-effect is not sharply localized, but seems to be concentrated in the central part of the field of vision.

Szily accounts for the phenomenon on the basis of contrast with the normal after-movement which he always sees in the periphery. The contrast is based upon a difference of threshold for movement. I am desirous of securing more data before accepting or rejecting this interpretation.

SUMMARY AND CONCLUSIONS

1. Visual after-movement is a complex phenomenon and its causes will not admit of reduction to unity.

¹ *Op. cit.*, p. 72.

2. The factors in its production are: retinal changes (probably fading after-images), association factors and strains in the ocular muscles. Either of these three may dominate over the others. Retinal changes may produce an after-effect even though this is opposed to the strains and association factors then active. Eye-muscle strain may inhibit any after-effect although the retinal factors and possibly the association factors are opposed to it. The same is true *mutatis mutandum* of the interpretative or associative factors.

3. The after-movement from a system of parallel lines is caused by all three of the factors above mentioned.

4. The after-movement from a rotating spiral is predominately of a retinal origin.

5. Asymmetrical eye-muscle strains (to which an effective nystagmus would reduce) may cause apparent movement of a stationary system of parallel lines. If the real movement of the drum is observed with one eye only and the after-effect is sought for with the other eye only, the search is successful. This can be accounted for on the basis of the harmonious action of the eye-muscles. A similar explanation holds for most cases of binocular fusion of the after-effects.

6. Stimulation of the eyes by movement (parallel lines) of large extent gives anomalous results. Two movements are seen, one going in the *same* direction as the real movement and one in the *opposite* direction. The explanation of these after-effects is still to be sought.

A COMPARISON OF THE ORDER OF MERIT METHOD AND THE METHOD OF PAIRED COMPARISONS

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The order of merit method as we know it to-day was first employed by Professor Cattell in his study of 200 shades of gray. This method consists in the arrangement of the specimens of the series when all of the specimens are presented to the subject as a series. The paired comparisons method involves comparing every specimen in the group directly and separately with every other specimen, the relative order in the final series depending on the number of preferences given to each specimen. This method of course takes longer and is more tedious both to operator and to subject than is the order of merit method.

The present experiment is an attempt to compare these two branches of the serial method in their statistical applications for the sake of determining their relative ease, reliability and consistency. Such a comparison is important in view of the fact that the one method is vastly to be preferred to the other in convenience of its operation.

The materials used in this experiment were of three kinds, selected with a view to a comparison of the two methods in their application to three types of judgment, viz., very objective judgment, semi-subjective judgment, and very subjective judgment.

Weights were chosen as material presenting an objective order definitely and mathematically prescribed. The series used included 15 weights identical in outward appearance but varying as follows: increasing by uniform increments of 4 per cent.; 100 gr., 104, 108.2, 112.5, 116.9, 121.7, 126.5, 131.6, 136.9, 142.3, 148.0, 153.9, 160.1, 166.5, 173.6 gr.

As a material involving semi-subjective judgments the

specimens of handwriting were used which are presented by Thorndike in *Teachers College Record*, Vol. XI. These specimens are graded in a scale of excellence as determined by the average opinion of competent judges in general. This scale is a semi-subjective one, in that it depends solely upon the average opinion of competent judges and cannot be referred to physical scales as weights can. The Thorndike scale is the result of some 20,000 ratings and represents measurements far more accurate than any one could make without it. The specimens used in this experiment are those numbered 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, in the scale.

The material used for a comparison of the two methods in very subjective judgments was a series of propositions to be ranged by the subject according to the degree of belief in the fact stated by the proposition. There is no objective scale whatsoever for the measurement of belief in these propositions as there is for the measurement of weights and excellence of handwriting. The criterion of accuracy in this type of judgment is, in this case, simply the average arrangement by the individuals of the given group.

The propositions in their order of belief according to the subjects passing judgment in this experiment, are as follows, by the order of merit method. (The figures in parentheses at the left indicate the position of the given proposition by the method of paired comparisons.)

1. $2 + 2 = 4$.
2. There exists an all-wise Creator of the world.
3. Geo. Washington was a real person.
- (5) 4. Music more nearly approaches the divine than does poetry.
- (4) 5. Vergil wrote the *Aeneid*.
- (7) 6. Man has evolved from one-celled protoplasm.
- (6) 7. The most honest man I know will be honest ten years from now.
8. Dark-haired men are handsomer than light-haired ones.
- (11) 9. Death ends individual existence.
- (9) 10. The moon is larger than Jupiter.
- (12) 11. It never rains but it pours.
- (10) 12. It will rain next 4th of July.
13. Only the good die young.
14. Opals are unlucky.
15. $2 + 2 = 7$.

The subjects in this experiment were students in Barnard

College in the regular laboratory course in experimental psychology. For each type of judgment investigated ten subjects arranged the specimens by both methods. The ten were divided into two groups; five of them arranging the specimens first by the O. M. method and one month later by the method P. C., and the other five arranging them first by the P. C. method and one month later by the O. M. method. This plan eliminated any error which might arise through one method assuming a superiority over the other by virtue of the precedence of one or the other in order of presentation. This plan also offers an opportunity for an investigation of the problem suggested by Lilien J. Martin, as to whether one of the methods under consideration must be supplemented by the other if the best results are to be obtained (14). Although the method to which she refers by the name of 'the method of constant differences' does not correspond exactly to the method of paired comparisons as it has been used in this experiment her proposal to supplement one of these methods by the other suggests an interesting incidental problem in the present attempt to compare the relative merits of the two methods. The fact that in one group of subjects the series was arranged first by O. M. and later by P. C.—and that in the other group this order was reversed, offers the basis for an observation of the reciprocal effects of the two methods.

The method of paired comparisons, a long and tedious one, was reduced in this experiment to its lowest possible terms by a special system, which enabled the experimenter to present the pairs to all of the subjects at the same time—one subject being presented with one pair while another subject was presented with another pair, etc. This was accomplished by a modification of the system of exhibiting the pairs which was used by Cohn. The latter consists in a presentation in the following order: 1-2, 3-1, 2-3, 4-2, 3-4, 5-3, etc., each pair involving as one of its numbers one of the specimens used in the preceding pair—and one to be used in the pair immediately following. According to this system, if the pairs are to be exhibited say to 5 or 10 subjects, the second pair, involving

one of the specimens belonging to the first pair, could not be exhibited until the first pair had been judged by all the subjects and had been returned to the operator. In order to be able to have several pairs in circulation among the subjects simultaneously the series of combinations was rearranged in groups which included in successive pairs only those specimens not already upon exhibition in another pair of the group. For instance if the pairs 1-2, 3-4, 5-6, etc., be exhibited, seven pairs could be in circulation simultaneously in regular order, so that the subjects having been provided with a plan of the order of presentation, could indicate as each pair came to them their preference for one specimen or the other. Thus the weights having been numbered at random were exhibited in pairs, each subject after having passed her judgment on each pair as it came—passing that pair to the next subject, and receiving, on the other hand, the pair just judged by the subject preceding. The operator receives the specimens as they come from the last subject in the group—and selects, according to the fixed plan, the new combinations which are to enter circulation. The subject simply writes, after each number on the outline with which she is provided, the number of the weight preferred—or simply R or L according as she prefers the specimen on the right or left. The specimens of handwriting and the belief propositions were pasted on separate pieces of cardboard—and the combinations inserted into heavy cardboard frames which were passed from one subject to another.

In this way 105 combinations of the 15 specimens of the given series were judged by five subjects in about 50 minutes for weights—in about 40 minutes for handwriting—and from 40-50 minutes for beliefs. The time required for the judgment of a series by the O. M. method will average about 5-8 minutes for each person, varying with the material to be judged. If duplicate series are available, as they are with beliefs and handwriting for example—the series could be presented to the whole group in the time required for one person to make the judgment.

In working up the results obtained by the two methods,

the demand upon the time and energy of the experimenter is increased many fold in the case of the method of paired comparisons. The number of preferences for each of the 15 specimens must be counted up for each subject, and the serial order determined according to the number of preferences given. This requires from 15-30 minutes for each subject's judgment of any given series. In the O. M. method the serial order is already determined by the judgments themselves, and no further computation is necessary.

The time required for judging the series of weights in this experiment was longer than that required for handwriting because of the fact that the weights represented differences just perceptible, whereas the specimens of handwriting represent differences much more easily discerned. An interesting problem would be to work out, for different sorts of materials, series in which the difference between the specimens for any given material would be psychologically equal to the differences between the corresponding specimens of any other material.

The results obtained in this experiment can not be used in a strict comparison of the two *materials*, weights and handwriting but are intended mainly as a basis for comparison of the two *methods* used, and the materials may vary in many ways.

Procedure.—In the first month, November, 1912, the series of beliefs and the series of handwriting specimens were presented to five subjects separately with the following written instructions. For beliefs: "Arrange these propositions in an order of merit according to the degree of your belief in them. Place at the top the proposition in which you believe most firmly. Place next, the second in the order of belief and so on until the series is complete, with the proposition in which you believe least of all at the end of the series. (Please do not discuss the experiment with other members of the class.)" For handwriting: "Arrange these specimens of handwriting in an order of merit with respect to their excellence. Place at the top of the series the specimen which you judge to be the best. Place next to this, the specimen which you judge

to be next best and so on until all have been placed in order with the one you judge the poorest at the bottom of the series. (Please do not discuss the experiment with other members of the class for the time being.)"

In the same month, five other subjects judged the given specimens of handwriting and of beliefs by paired comparisons, according to the plan described above. The instructions, understood by each subject before the exhibition of the pairs, were as follows: For beliefs: "I shall present to you, two by two, a series of propositions. As each pair comes to you, decide in which of the two propositions you believe more firmly—and designate the one in which you believe more firmly by writing its number (I. or II.) in the space designated by the plan of presentations." Each pair exhibited was inserted into a cardboard frame with the numbers I. and II. by which to designate the two specimens. The plan of presentations was a sheet of paper for each subject on which columns of figures were arranged in order of the presentation of the various combinations, 27 in the first column, 23 in the next, 19, 15, 11, 7, 3, making the familiar

||||| plan of the paired comparisons order of presentation.

In the second month, December, 1912, the two groups were reversed; each doing what the other had done one month before.

In the third month, January, 1913, a new group of ten subjects was selected to judge the weights. Five of them made the judgment by order of merit under the following instructions: "Arrange these weights in an order of their heaviness, in a row on the table. Put the heaviest weight at the left end, the lightest weight at the right end, and the others ranged accordingly between them."

The other five made the judgment by paired comparisons with the following instructions: "I shall present to you, in pairs, a series of weights. As each pair comes to you, lift each weight successively with your right hand, decide which of the two is the heavier, and indicate the heavier weight by writing its number in the space designated by the plan of presentations." (The weights were numbered at random.)

In the fourth month, February, 1913, these two groups exchanged methods as the others had done.

The data obtained in these experiments offer material for the investigation of several problems connected with a comparison of the two methods.

TABLE I

WEIGHTS

Grams	Order of Merit			Paired Comparisons		
	Av.	Av. Order	Av. Variation	Av.	Av. Order	Av. Variation
173.6	1.1	1	.18	1.25	1	.35
166.5	2.5	2	1.00	1.85	2	.24
160.1	3.5	3	.90	3.05	3	.28
153.9	4.3	4	.76	4.20	4	.38
148.0	4.8	5	1.20	5.00	5	.50
142.3	5.6	6	1.04	6.00	6	.40
136.9	7.0	7	1.00	7.50	7	.85
131.6	7.8	8	.52	7.70	8	.96
126.5	9.0	9	.60	8.40	9	.66
121.7	10.5	10	1.20	10.80	11	.38
116.9	11.2	12	.68	10.50	10	.50
112.5	11.1	11	1.30	11.90	12	.49
108.2	12.9	13	.54	13.40	13	.58
104.0	13.9	14	.54	14.10	14	.54
100.0	14.8	15	.32	14.40	15	.68

TABLE II

HAND-WRITING

No.	Order of Merit			Paired Comparisons		
	Av.	Av. Order	Av. Variation	Av.	Av. Order	Av. Variation
18	1.4	1	.64	1.10	1	.18
17	2.4	2	.68	2.55	2	.97
16	3.7	4	.82	3.32	3	.60
15	3.2	3	.92	4.42	4	1.34
14	4.9	5	.76	5.45	5	.86
13	6.1	6	.92	6.50	6	.96
12	6.7	7	.76	6.62	7	1.20
11	8.1	8	.36	7.85	8	.38
10	8.5	9	.80	8.87	9	1.08
9	10.0	10	0	9.85	10	.38
8	11.1	11	.18	11.30	11	.48
7	11.9	12	.18	11.80	12	.62
6	13.2	13	.32	13.10	13	.54
5	13.8	14	.32	13.90	14	.46
4	15.0	15	.00	14.85	15	.27

TABLE III
BELIEFS

No.	Order of Merit			Paired Comparisons		
	Av.	Av. Order	Av. Variation	Av.	Av. Order	Av. Variation
I.	1.1	1	.18	1.50	1	.40
II.	3.1	3	.36	3.25	3	.95
III.	2.9	2	1.64	2.90	2	1.86
IV.	5.6	4	1.52	5.25	4	1.00
V.	6.3	6	3.46	7.55	7	3.88
VI.	6.0	5	.90	5.30	5	1.66
VII.	7.1	7	1.10	6.60	6	1.80
VIII.	8.3	9	2.90	10.55	11	2.36
IX.	7.9	8	1.70	8.25	8	1.65
X.	11.2	12	1.08	10.15	10	1.25
XI.	10.5	10	2.60	9.40	9	3.00
XII.	10.6	11	1.28	10.95	12	1.26
XIII.	12.7	14	1.36	12.55	14	1.64
XIV.	12.0	13	1.40	12.10	13	.94
XV.	14.7	15	2.97	14.25	15	.75

On the basis of the data indicated in the accompanying tables of results we may formulate the following problems, each of which involves a comparison of the two methods with reference to that problem.

I. The variability of each specimen from the average position accorded to that specimen—and the average variability of the series for each method and for each type of judgment.

II. The correlation of the average order with the objective order by each method in the case of weights and that of handwriting where the objective order is already determined.

III. The correlation which obtains between the arrangements made of any given series by the one method and the arrangements made of that series by the other method.

IV. The average correlation of the individual subjects with their group average—by the one method and by the other.

V. A correlation between the individual's correlation with the group by the one method and the same individual's correlation with the group by the other method. This will show whether an individual who is representative of his group by the O. M. method is also representative of his group by the P. C. method.

TABLE IV

Obs.	Individual Correlations with the Group				Variability of the Series		Correlation with Objective Order		Correlation of Methods	
	Order of Merit		Paired Comparisons							
	<i>r</i>	Variation	<i>r</i>	Variation	O.M.	P.C.	O.M.	P.C.		
WTS:										
Cr.....	.925	.037	.975	.010						
D.....	.982	.019	.964	.021						
F.....	.975	.012	.972	.013						
M.....	.983	.020	.986	.001						
W.....	.939	.024	.993	.008						
B.....	.939	.024	.993	.008						
Bu.....	.964	.001	.997	.012						
Ca.....	.947	.016	.983	.002						
G.....	.986	.023	.989	.004						
McC.....	.989	.026	.993	.007						
Av.....	.963	.020	.985	.009						
HAND-WRITING:										
G.....	.993	.012	.988	.016						
H.....	.918	.063	.963	.009						
R.....	.997	.016	.991	.019						
R'.....	.986	.005	.981	.009						
S.....	.972	.009	.902	.070						
B.....	.986	.005	.957	.015						
L.....	.979	.002	.975	.003						
Mc.....	.993	.012	.974	.002						
P.....	.989	.008	.997	.025						
Y.....	.997	.016	.988	.016						
Av.....	.981	.015	.972	.018						
BELIEFS:										
G.....	.881	.012	.884	.025						
H.....	.881	.007	.935	.024						
R.....	.917	.048	.870	.011						
R'.....	.981	.107	.949	.090						
S.....	.918	.049	.880	.021						
B.....	.790	.079	.780	.079						
L.....	.832	.037	.896	.037						
Mc.....	.943	.074	.903	.044						
P.....	.777	.092	.750	.109						
Y.....	.820	.049	.740	.119						
Av.....	.874	.055	.859	.056						

VI. A comparison between an individual's correlation with the average in handwriting and the same individual's correlation with the average in beliefs—by the two methods.

VII. A comparison of the group who made their judgments first by the O. M. method with the group who made their judgments first by the other method. This involves a com-

parison of the two groups with reference to the possibility of the judgment by either method being improved by the fact that the other method preceded it.

IX. A conclusion based upon all of these comparisons, and upon other points of comparison indicated by the actual employment of the two methods in this experiment and in their historical development.

DISCUSSION OF RESULTS

I. The average variability of the position of each weight from the position of that weight as determined by the average opinion, is, by the order of merit method, slightly greater than it is by the other method. With the handwriting the exact opposite of this is true. It is impossible to determine whether this difference is due to the difference in material or to the difference in the individuals arranging the material.

It is of course conceivable, taking these averages in isolation, that the P. C. method is particularly adapted to judgment of weights and the O. M. method to judgments of handwriting. This however is disproved by the exceedingly high correlation of the two methods with a given material.

It might possibly mean that the one method is particularly favorable to the one group, and the other method to the other—but a comparison of the variabilities in beliefs with those in handwriting shows that the group which performed both of these types of judgment does not consistently prefer the one method to the other at all. Averaging the average variations for the three types of judgment we find a difference of only .08 between the two methods.

These differences in variability then may be due to the materials themselves, apart from any influence of methods, or they may be due to the groups themselves, apart from any consideration of methods; but they are evidently not due to any influence of the methods themselves.

The relatively high degree of variability in the arrangement of the beliefs is an interesting index to the subjectivity of the material. The subjectivity of the judgments of handwriting as compared with those of weights is obscured prob-

ably by the fact noted above that the differences between successive weights were differences just perceptible, while those between successive specimens of handwriting were much more easily discernible. In other words, subjectivity of judgment may be due either to individual variation in the standards or to the smallness of the differences presented, and in the present case these two types of subjectivity are not isolated.¹

II. In the judgment of weights the correlation of the average order as determined by the group arrangements, with the objective order as determined by the weights in grams, is exactly the same for the one method as it is for the other. In the judgments of handwriting the correlation with the objective order is almost identical for the two methods—representing a difference of only .003 in favor of the P. C. method. The correlations between average order and objective order are practically identical for the two methods.

III. It may be seen from the table of correlation results that the order obtained by means of one method in a given material is almost identical with the order obtained in the same material by the other method. This would seem to indicate that the two methods are interchangeable from the standpoint of direct results alone as well as from the standpoint of variabilities and correlations with the objective order.

The correlation between the two methods does seem to vary slightly with the material judged. There is a possibility that subjectivity of judgment if it were greatly increased might involve a variability in the results as obtained by the one method or the other. In the present experiment however the correlation between the two methods even for beliefs is almost .98.

The average correlation between the two methods for the three types of judgment is .987. This indicates that it were very unnecessary to employ either of these methods which for any reason is less to be preferred than the other—if the purpose is to obtain merely general results.

¹ Cf. Hollingworth, 'Experimental Studies in Judgment,' Ch. X.

IV. The individuals of the group correlate with their average almost exactly as well in one method as in the other. The differences in the averages of the individual correlations with their group in the two methods lie in every case within the limits of the probable error of those correlations. This means that the two methods are equally efficient if we consider their results from the point of view of individual differences in variability from the group average. The individuals on the whole depart from their group no more in one method than in the other.

V. The *individual's* correlations with the group average are so nearly identical in the two methods that a comparison can hardly be made between an individual's standing in relation to his group in one method and his standing in relation to his group in the other method. Where these differences are large enough to be considered there is a fairly high correlation between the two methods in this respect. An individual who represents his group in O. M. also tends to represent his group in P. C. This correlation in both handwriting and beliefs is $+.70$. In weights the relation between the two methods in this respect is almost a random one ($r = +.01$). The cause for this is not apparent unless it is due to the fact that the individual differences in correlation by P. C. are so very insignificant as to make the order of correlations subject to chance and very unreliable. (The average variation among these is only .009.)

The judgments in handwriting and beliefs would indicate a tendency for the individual who is representative of his group in the one method to be also representative of his group in the other method.

VI. Having determined whether an individual representative in one method is representative also in the other, it is interesting to determine whether an individual representative of his group in one type of judgment is also representative in another type of judgment. This latter determination must be based upon a comparison of the judgments of handwriting and of belief only, since the weights were judged by an entirely different group of subjects.

By the O. M. method there is simply no relation at all between a person's judicial capacity in handwriting and the same person's judicial capacity in beliefs. The correlation between the two orders of the individuals in the group, the one as they stand in handwriting judgments, the other as they stand in judgments of beliefs, is expressed by the figure .01, a zero correlation.

By the method of P. C. this correlation is increased in a negative direction to $-.35$ although there is no apparent reason why, in P. C., there should be a tendency for an individual who is a good judge of handwriting to be on that account a poor judge of the validity of propositions. The negative correlation in this instance remains a mystery—and the fact that this correlation varies from a corresponding correlation obtained by the other method offers the first and only discrepancy in the equal efficiency of the two methods.

VII. Does a given method tend to give better results when it has been preceded by the other method than it does when used alone?

In order to answer this question we may compare the average correlation of the individuals of one group with the average correlations if the individuals of the other group, through the use of the one method and of the other. The following table shows these average correlations for the two groups—by the two methods and for each type of judgment. The group in which the P. C. method preceded the O. M. method, we may call the P. C. group. The group in which O. M. method preceded the P. C. method, we may call the O. M. group.

The averages are as follows:

	P.C. Group		O.M. Group	
	P.C.	O.M.	O.M.	P.C.
Wts.....	.987	.961	.965	.990
H.W.....	.965	.973	.989	.978
Beliefs.....	.903	.906	.832	.814
Av.949	.947	.929	.927

If we assume that the method which is the second to be performed tends, on that account, to give better results than the one first performed, then the figures in the second column would tend to be greater than those in the first, and the figures in the fourth column greater than those in the third.

Now the figures are such that, in comparing the two groups in a given method, if the second column be subtracted from the third (the second group excelling the other in the O. M. method), then the first must be subtracted from the fourth (the second group excelling the other also in the P. C. method). Where the case is reversed and the first group excels the second, then if the third column be subtracted from the second then the fourth must be subtracted from the first.

In the first case, if our main hypothesis is to be proved, viz. that column 2 > 1 and column 4 > 3, then (col. 3-col. 2) < (col. 4-col. 1).

This is not the case however either in judgments of weights or in judgment of handwriting.

Neither is it true in beliefs that (col. 2-col. 3) > (col. 4-col. 1) as would necessarily be the case if the main hypothesis were a valid one.

Thus if the figures used in this problem were sufficiently large to be significant this experiment would prove conclusively that in weights, handwriting and beliefs, the method which is done first does not tend in any way to improve the judgments made by the method which follows it a month later. The figures are, however, entirely too small to be of any practical significance.

The two methods correlate so clearly that there is no basis offered for comparing even the effect of one upon the other.

SUMMARY

From the foregoing discussion of results we may conclude:

1. The variability of the specimens of a given series from their average positions is not influenced in any way by the fact that the series has been judged by one of the two methods rather than by the other. In this respect the two methods may be considered equally efficient.

2. The correlations between the average order of the given series and the objective order of that series are practically identical for the two methods. With respect to this aspect of the problem the two methods may be considered equally efficient.

3. The average correlation between the two methods for the three types of judgment is .987. This indicates the absence of any basis for preference of one method over the other—with respect to the general results obtained.

4. The individuals as a whole depart from their group average no more in one method than in the other. This proves the equality of the two methods as means of investigating average variability of the individuals of a group.

5. A single individual who is representative of his group in one method tends to be representative of his group in the other method also. This indicates the equal efficiency of the two methods as applied to an investigation of a problem of this sort.

6. The two methods disagree slightly in their indications as to the relation between ability to judge handwriting and ability to judge beliefs. An investigation might be made to test further the validity of this discrepancy.

7. The method which is done first does not tend in any way to improve the judgments made by the method which follows it a month later. This would indicate that neither of the two methods is necessary as a supplement to the other.

CONCLUSIONS

On the basis of these conclusions as to the efficiency of the two methods in their particular application we may say that one is in no way to be preferred to the other.

On the basis of historical and empirical criticism as to the relative merits of the two methods we may say

1. That the order of merit method is vastly to be preferred to the method of paired comparisons, from the standpoint of their relative demand upon the time and energy both of the experimenter and of the subjects.

2. That the order of merit method is to be preferred in

that it requires a subject to give each specimen of the series its own separate rank. (By the method of paired comparisons two, three or four specimens may be given the same number of choices and thus be indeterminate as to their real position in the series. The subject is not forced to make a choice between them.)

3. That Cohn's objection to the order of merit method that it fails to give a real quantitative ranking of the series, as does the P. C. method, has been successfully refuted by Thorndike who has proposed a method of determining the quantitative values of the specimens of a series on the basis of their curve of distribution.

4. That Titchener's theory that the method of Paired Comparisons is necessary for the internal control of introspection—and Des Bancel's observation that this method "*est plus naturel et rappelle les procedes ordinaires de choix auxquels nous recourons dans la vie et tous les jours*" (15) take the method out of the realm of statistics and designate its own particular field of efficiency in a psychology of pure introspection rather than of statistical measurement.

If, as Bullough maintains (16), experimental æsthetics be simply a matter of introspection and absolutely divorced from statistics, then it would seem that this method could retain something of its former prestige as a means to the investigation of the introspective æsthetic reaction. Its efficiency, even in this line, however, is denied by Gordon, who, in a recent experimental work in æsthetics, dismisses the method peremptorily with the statement, "The method of paired comparisons was discarded after some trials. Any one who has tried it with æsthetic tests will recognize the serious objection against it that it so quickly exhausts the æsthetic reaction" (17). This statement as it stands has not been refuted. It remains for the introspector to decide whether the method of paired comparisons is to maintain its experimental existence even as a vehicle of æsthetic introspective analysis.

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THE SYSTEMATIC OBSERVATION OF THE PERSONALITY—IN ITS RELATION TO THE HYGIENE OF MIND

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CONTENTS.

	PAGE
Scope of the Problem	295
I. Intellectual Processes ¹	300
II. Output of Energy	302
III. Self-Assertion	303
IV. Adaptability	304
V. General Habits of Work	305
VI. Moral Sphere	307
VII. Recreative Activities	308
VIII. General Cast of Mood	311
IX. Attitude towards Self	313
X. Attitude towards Others	314
XI. Reactions to Attitude toward Self and Others	317
XII. Position towards Reality	320
XIII. Sexual Sphere	324
XIV. Balancing Factors	326
Conclusion	331

SCOPE OF THE PROBLEM

The object of this paper is to give an orderly presentation, susceptible to quantitative treatment, of the essential factors in the proper mental adjustment of the personality to its environment, specifying the character of healthy mental reactions as distinguished from unhealthy ones. But so long as the qualities involved here are not capable of direct experimental measurement, the only approach, of the quantitative character that science demands, is the evaluation of comparative judgments about them. Such a way of dealing with this class of data has had its greatest development in the method of measurement by relative position, one of the

¹ The divisions are after Hoch and Amsden's 'Guide to the Analysis of Personality' (unpublished).

major indebtednesses of psychology to James McKeen Cattell. The fundamental principle is that whatever are the topics for inquiry in the study of the personality, the information *must* be cast in such a form as to give a judgment of the quantitative relationship of the subject to other individuals.

Experimental psychology has carried the formal aspects of the problem to a high degree of perfection. Less help is derived on the side of content, of the special topics of inquiry, partly because the statistical complications of the problem absorbed the major share of attention, and also because the conventional subject-matter of psychological study is not of a character to readily lend itself to progress in that particular direction.

One has been dependent rather on the study of those individuals whose faulty mental reactions bring them into clinical contacts, where the personality is observed at closer range, and under fewer conditions of dissimulation. This view of the personality lays a somewhat different emphasis upon its factors than is found in the usual psychological analyses. Those based upon the ordinary experimental procedures are limited to elementary motor and intellectual measures which are notoriously difficult to interpret in a dynamic relation to the personality. But even with the more refined methods of standardized judgment, the tendency has been to consider the personality in a primarily social way; according as we who observe it react to it, whether one's characteristics are such as to make him a useful, efficient and successful member of the community. For the present problem it is more relevant to consider human qualities as they make for the individual's satisfaction with life, capacity to maintain a wholesome outlook on existence. One viewpoint deals with a man's value to society, the other with his personal adjustment to it. One's external success is particularly related to the intellectual and volitional spheres, the subjective balance being more especially an affair of disciplined affective life. The difference in standpoint is most concretely illustrated in the comparison of such schemata as the Cattell series with its admirably quantitative features, and the

original Hoch-Amsden "Guide," of previous reference, with its more specific and searching content.

The paper by Hoch and Amsden of subsequent reference, and the present paper, are intellectual descendants of this 'Guide.' The essential differences between the revised schema of Hoch and Amsden, and the present, are: (1) the Hoch-Amsden is not limited to quantitative treatment, therefore can, and does, question more specifically; (2) its classification has been largely rearranged in correspondence with the author's special system of psychology. Save for these considerations, the two schemata are in such close accord that in the parallel columns below, the topics of the Hoch-Amsden are included only where they especially *supplement* the quantitative series of the present writer. The topics of this latter may be considered, in nearly all cases, as also implicit in the Hoch-Amsden.

The term 'mental balance' is used in both static and dynamic senses. In the dynamic sense an individual is well-balanced when he is in good mental adjustment to his environment. Such mental balance is disturbed in various psychogenic difficulties, 'conflicts,' 'tangles,' being also a function of the environment in that individuals may be able to maintain their balance in simpler situations but not in more complicated ones. In this regard, traits are important not only for themselves, but according to their combinations. The same self-assertiveness, for example, that leads one individual to realize his aspirations, leads one less well endowed into situations he cannot cope with, thus strengthening the mental balance of the one, and undermining that of the other. The unhappy effects of an over-sensitive nature are somewhat offset by a forgiving disposition; incompetence by a lack of desire for better things. The dynamic side of mental balance is mental adaptation. In this sense, it is a problem for solution.

In the static sense, mental balance is a function, for measurement. We speak of an individual as the better balanced, the greater difficulties it takes to upset him, or the greater variety of situations to which he can adapt himself;

just as a well-'balanced' ship maintains its stability in the roughest water, while 'top-heavy' ones are endangered even in a moderate sea.

Our immediate *Aufgabe* is to bring together the various sources of material considered, and by their means to construct an outline of personality that shall concretely state the factors of importance to well-adjusted character, and make possible the direct comparison of personalities in quantitative terms. Such an outline deals partly with attributes of character that may be the cause of difficulties, as sensitiveness or self-consciousness, and partly with reactions that may be the result of difficulties, as bashfulness or evil-speaking. There is, of course, a good or vicious circle in these traits. These schemata are easier to follow if they are divided in some way, and a very suitable division seems to be that of the original Hoch-Amsden 'Guide,' which is followed practically verbatim save for one additional section of *Recreative Activities*. The divisions, of which there are fourteen, are not intended to be rigid, nor could they be made so. The topics considered under *Recreative Activities* are in many respects continuous with those of *Balancing Factors*. Certain points under *Attitude towards Others* are obviously related to *Adaptability*. No single characteristic can be absolutely separated from other characteristics, any more than a single act is the product of a single motive.

The manner of presentation is to enumerate under the title of each division first the topics that are arranged under it to form a part of the present system. They are formulated not in the simple names of qualities, as in the schemata of Cattell or Davenport, but in the form of questions, similar to the Heymans-Wiersma and the Hoch-Amsden; *e. g.*, *how well does he keep his word, how sociable is he*. This often gives a sharper definition than is possible through single names of qualities. Immediately following these are quoted under each section the topics that best fit under it from (1) the revised scheme of Hoch-Amsden (those of a *supplementary* nature only, *cf. above*), (2) the list of Heymans and Wiersma, (3) the series arranged by Professor Cattell, (4)

selections from the 'Trait-Book' of Davenport. These will further indicate the scope of each division, as well as different ways in which its topics may be approached. There is then added a brief discussion of each division, more closely defining the topics of the present schema, and the relation of each section to the others and the entire series.

As the successive topics for inquiry are enumerated, five personalities are described in terms of them, that the actual working of the schema may be illustrated. Naturally the information is in every case furnished by one intimately acquainted with the individual concerned. The method of notation is similar to that recommended for the Binet-Simon scale. The excess of the attribute, *in relation to the average*, is indicated by a + sign, its deficiency by a - sign. One or the other attaches to every topic enumerated. In the case of marked presence or predilection or correspondingly marked aversion the symbol (!) is appended to either sign, in case of doubt the symbol (?); *e. g.*, *how conscientious*, - ?, how sociable, +!. This affords six steps, as follows:

- +!, marked presence above ordinary,
- +, distinct presence above ordinary,
- +?, doubtful presence above ordinary,
- ?, doubtful deficiency or aversion,
- , distinct deficiency or aversion,
- !, marked deficiency or aversion.

(If one wishes to indicate that the judgment rests upon information of doubtful sufficiency, this is conveniently done by a ? placed *before* the + or - sign. Absolute lack of data for judgment is represented by X.)

These + and - signs are suggested for their naturalness, and the ease with which the associations are formed. It need scarcely be said, however, that any quantitative method of notation may be applied to such a series of inquiries. They may be graded on a percentage basis, compared with a standard objective scale, evaluated by whatever method the investigator may prefer or the refinement of his working conditions permit.

It would have been very agreeable if the topics could have been so worded that + signs should represent qualities advantageous to the personality, and - signs disadvantageous ones, but there are obvious linguistic as well as psychological difficulties. Finally, it will be remembered that the qualities are intended to be estimated, not directly from the informants' statements, *but from the examiner's judgments based upon more detailed questioning*. Both content and manner of informants' replies, as well as all incidental features, are proper aids towards arriving at a judgment, and a certain discretionary competence in dealing with the obtainable data must always be assumed.

In the present instances, it may be observed that two are comparatively good personalities, presenting only minor or well compensated difficulties; another less favorable, pre-

I. INTELLECTUAL PROCESSES

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
How easily does the person learn.	+!	+?	+?	+?	+
How good a memory.	+!	+!	+?	+	-?
What fund of information (relative to educational opportunity).	+	+?	-	+	+
How well able to observe.	+!	+	-	+	+
How vivid mental imagery.	+?	+?	+	-	+

<i>Hoch-Amsden</i> ¹	<i>Heymans-Wiersma</i> ² (Abridged)	<i>Cattell</i> ³	<i>Trait-Book</i> ⁴
Is he considered to have good common sense?	Take things in readily	Intellect	Attention
Is his advice sought by others?	Broad	Clearness	Retentiveness (of memory)
Does he plan with good foresight?	Special Talents	Originality	Selectiveness (of memory)
	Good observer	Breadth	Sense-imagery
	Ear for music		Sound (tone-deafness?)
	Memory		
	Retain reading		
	Abstract speculation		
	Absent-minded		

¹ Hoch and Amsden, 'A Guide to the Descriptive Study of the Personality, with special Reference to the taking of Anamneses of Cases with Psychoses,' (N. Y.) *State Hospital Bulletin*, Nov., 1913, pp. 12.

² Heymans and Wiersma, 'Beiträge zur speziellen Psychologie auf Grund einer Massenuntersuchung,' *Zt. f. Psychol.*, 42, 1906, 81-127; 258-301, *et seq.*

³ Cattell, 'Homo Scientificus Americanus,' *Science*, N. S., 17, 1903, 561-570.

⁴ C. B. Davenport, 'The Trait Book,' Eugenics Record Office Bulletin No. 6, 1912. The number of schemata that could be treated in this way is of course indefinite.

senting more sources of difficulty, but still fairly well handled, and two decidedly unfavorable, with many pronouncedly harmful traits, not well reacted to.

The rôle of the intellectual faculties in the personality is a subordinate one, though in some ways they influence its development secondarily. As Birnbaum points out, there are numerous features of character, as the higher religious and æsthetic perceptions that are possible only in the presence of a superior intellect; furthermore the degree of intellectual capacity contributes somewhat to the position one reaches in life, and the complexity of the situations one is called upon to adjust. If one's intellectual powers lead him into situations beyond his capacity to deal with in other respects, difficulties of adaptation will follow just as when one's ambition leads him to strive to a higher level than his intellectual capacity will support. To one individual the intellect may provide an excellent balancing material, while in another it serves only to aid in the elaboration of difficulties and inadequate adjustments to them.

The facility of acquiring ideas and the ability to retain them being two fundamental traits of intellect, information regarding these may be sought through school records, the individual's readiness to 'take in things' in later life, as well as the general quality of memory. Some rating should be possible in respect to the general extent of present knowledge, always however in proportion to the opportunities which there have been to learn. To inquire into the breadth of intellectual pursuits, the presence of special talents, the power of attention or concentration, as well as the selective faculty of the memory, are all above suggested as helpful in elucidating these questions. The matter of originality in thought may also enter here, if one wishes to distinguish it from that of resourcefulness in action. In spite of the difficulties in scaling, the clearness of sense-imagery cannot be left out of account, for besides its immediate interest, it is very important in relation to *Einbildung*,¹ since the latter can be largely determined by the vividness of the imagery it

¹ Cf. Position towards Reality, p. 322.

involves. In fact, there are few more inclusive questions for the mental balance of an individual than the tendency of the reactions to be dominated by imaginal stimuli.

II. OUTPUT OF ENERGY

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
H.-A.	H.-W.	C.	T.-B.		
How much motor activity.....	+!	+	-	-!	+!
How talkative:	-	+?	-	-?	-
How skilful with tools, needlework and the like:	+	-?	+?	+!	+?
What degree of bodily dexterity and grace:	-	+?	+	-	-

As is seen, this section covers the expenditure of activity in its grosser forms only. Here are included the individual's general motor habits, that of restless expenditure of energy, over and above that needed for the matter in hand, liveliness as opposed to general motor repose and economy of effort, if not actual sluggishness. Special queries regarding motor gracefulness and manual dexterity are also included here, because it seems that purely motor accuracy and coördination are often especially inefficient in a class of neurotics. The degree of interest and proficiency in athletic sports is often of value in arriving at a judgment in these matters. The information should be based on a general view of the individual's quickness and efficiency in motor adjustments. Linguistic habits are also considered here, and should be inquired into with some minuteness, because they are easy to judge, and seem closely related to deeper factors of make-up. The questions of Heymans and Wiersma review the matter very specifically and well. A person's manner of speech is a

not infrequent superficial means towards the estimate of character, and a full account of it is apt to be not far out of accord with the volitional side of the personality in general.

III. SELF-ASSERTION

		A	B	C	D	E	
How much effort to shape surroundings.....		+!	+!	-	+	+	
How independent of the opinion of others.....		+!	+!	-	-	+	
How much tendency to assume leadership.....		+	+	-	+	+!	
How ambitious in material things.....		+	+?	-	+	-	
How able to bear up under difficulties and misfortunes.....		-	+	+?	+	+	
How able to face crises:.....		+	+!	-?	+?	+!	
What inclination to face danger:.....		+	+?	-	-!	+	
H.-A.	H.-W.	C.		T.-B.			
	Independent Ambitious Courageous Courage in sickness Easily discouraged	Independence Courage Leadership		Suggestibility Coolness in emergency vs. loss of head Dignity, presence, vs. lack of dignity Ambition vs. apathy Pluckiness vs. disheart- edness Combativeness vs. sub- missiveness			

Few factors of character are of such import to material advancement as those here included. While the amount of effort to shape surroundings can be very largely a function of more fundamental topics to follow (as under *Position towards Reality*) it is desirable to put this question separately owing to its general intelligibility and concreteness. The social rise of a self-effacing makeup usually takes place only on the ground of very exceptional intellectual or sentimental endowments. It should be possible to say how much the individual has been inclined to assume leadership among companions, both in the adolescent period and later, whether not up to, or beyond capabilities.¹ An allied factor is that of suggestibility in a broad sense, as given in the independence of thought from that of others, in contrast to dependence on outside opinion. The character of ambitions should be considered, whether of a material or mental character, because

¹ To what extent does one influence the doings of others, causing them to act in his own interests?

the former demand more self-assertion than the latter, which are usually seen in those of less active tendencies. It has seemed advisable to include here the questions of capacity in danger and misfortune summed up in the conception of *courage*. One should consider the general willingness (*resp.* tendency) to face danger, as from actively courting death to the careful avoidance of activities involving the risk of even slight physical detriment. Further aspects are the retained capacity for adequate reaction under adverse conditions,¹ the similar capacity in sudden emergencies or crises, as well as the manner of enduring physical pain.

IV. ADAPTABILITY

	A	B	C	D	E
How get along with other children.....	+?	+?	+	-	-
How get along with people in older years (tactfulness).....	+	+	+	-	+
How conformable to discipline.....	+?	-?	+?	-!	+
What tendency to be guided by advice.....	+?	+?	+	-!	-?
How resourceful.....	+!	+	-?	-	+

H.-A.	H.-W.	C.	T.-B.
Is there a marked difference in his behavior in his intercourse with friends, family or strangers?	Change occupation	Coöperativeness	Resourcefulness <i>vs.</i> lack of resource
When a child did he play freely with other children?			Tactfulness <i>vs.</i> indiscretion
Is he tactful or offensive?			Coöperativeness <i>vs.</i> aloofness
Is he quarrelsome, or easy to get along with?			Obedience <i>vs.</i> disobedience
Can he cooperate with others?			
Does he readily adapt himself to new environments, as being away from home, moving to new places, etc.?			

Under the caption of *Adaptability*, Hoch and Amsden brought together certain broad themes of inquiry into the personality's adjustment to its environment. The stand-point is a synthetic one, taking the personality as a whole, and the general efficiency of its adaptive functions. No small importance attaches to the attitude which the per-

¹ Cf. James, 'Principles,' Vol. II., pp. 578-9.

sonality tends to inspire in others. Distinct unpopularity and inability to get along with playmates is an ear-mark of defective personality, more especially in childhood and adolescent days than later, because at the earlier time the harmful trends as well as the reactions of companions to them are more freely expressed. In later years, the difficulties are apt to find expression in ways that bring one less into direct conflict with the environment; Heymans and Wiersma suggest the question of stability in given lines of work, or tendency to changing occupation or situations. A similar test of character is the capacity to fit into organization, to learn to command by learning to obey, as opposed to a temperamental tendency to infractions of discipline. Hoch and Amsden also placed here the ability to take (*resp.* follow) advice; and while this topic also is perhaps covered under succeeding sections, it is retained as a function of adaptability, since this is also reflected in one's general amenability to the better judgment of others. The prompt ingenuity in meeting unaccustomed situations, the *Resourcefulness* of the 'Trait-Book' is a quality of some indirect value in social adaptation, though the immediate relation to the mental balance of the personality is not so distinct as in the other topics.

V. GENERAL HABITS OF WORK

	A	B	C	D	E
How prompt in reaction to situations.....	+	+	-	-	+
How systematic in work.....	+!	+	+	+?	+
How executive.....	+	+!	-	-	+
How persistent.....	+?	+?	+	+	+
How punctual.....	+?	+?	-	-	+

H.-A.	H.-W.	C.	T.-B.
Is he active or over-active by fits and starts?	Put things off Impulsive Decisive	Will Perseverance Efficiency	System Alertness <i>vs.</i> Sluggishness Decision <i>vs.</i> vacillation Promptness <i>vs.</i> procrastination Perseverance <i>vs.</i> capriciousness
Is he committed to a routine, or is he free and agile mentally?	Masterful Orderly Punctual		

The precise character of work done for a livelihood is of course a part of all records. The extent to which the per-

sonality determines it is variable, because not everyone is free to enter the occupation he is suited for, and a suitable choice is not always made. Different motives may operate in choosing, the individual may be well adapted to his work in one way and badly in another; besides which, it is relatively incapable of modification. Far from being a reaction of adaptation, it may be an important source of difficulties. These sources of error may be counteracted by direct effects of occupation on character, and in the popular mind, certain temperaments are indeed firmly associated with certain types of occupation. We consider certain types of personality as best adapted to literary, artistic, teaching, scientific, professional, commercial, or laboring careers, as well as looking to find different sorts of mental balance in them; thus one speaks of the 'live wire,' the 'artistic temperament,' the 'fatal gift of music,' the 'brother to the ox.' The danger here lies rather in exaggerating the importance of occupation as a criterion of personality than of minimizing it. So far as the life-work can, in any given case, be regarded as an expression of personality, its factors are unusually complex. The most important would seem to be (a) the extent to which it is of material or mental rewards, (b) the moral conditions obtaining in it, (c) the extent to which it is a function of intellect, emotion or activity, (d) whether it is of a practical as opposed to an affective appeal, and (e) the severity and immediateness of the competition it involves.

Certain common factors of work are more susceptible to inquiry along the present lines. Stress is commonly laid on the *promptitude* with which situations are adjusted; whether the reactions are impulsive, rapid, deliberative, or slow. The question of orderliness and system in contradistinction to desultoriness may be considered here as a general attribute of behavior, also that of decision or vacillation. This latter applies rather to the single reaction to a situation, separate provision being made for the persistence in a given line of activity, the *perseverance vs. capriciousness* of the 'Trait-Book.' A useful distinction may also be drawn between the general rapidity of response as above, where none but the

individual is directly involved, and the punctuality in meeting obligations towards others. This attribute grades into the section following.

VI. MORAL SPHERE

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
<i>H.-A.</i>	<i>H.-W.</i>	<i>C.</i>	<i>T.-B.</i>		
How well does the person keep a given word.	+?	+?	+	+	+?
How truthful in matters relating to present or past.	+	+	+?	+?	+
How trustworthy in money matters.	+	+	+?	-?	+
How conscientious in the performance of duty.	+	-?	+	+?	+!
How discreetly careful of the reputation of others.	+	+	+!	-!	+
How mindful of the equal rights of others.	+?	+	+!	+!	+

The consideration of this section presents some difficulties on account of the variable nature of the social criteria of morality. Furthermore, social morality does not necessarily run parallel to the mental hygiene of the individual. Many reactions that have a moral phase are included under other sections, there being placed under this one a small number concerned with some special standards of honorable conduct firmly grounded in the experience of the community.

In estimating qualities in this sphere it is regularly considered that the *moral* value of an act depends on the strength of the influences opposed to it in the person concerned. The test of truthfulness is the tendency to tell the truth to one's disadvantage, with the assurance of undetection in falsehood. Although society must be expected to react against transgressions of the social order as such, and recognize social conduct as such, without reference to its motivation, morality is from the present standpoint to be regarded rather as a subjective quality, to be measured in terms of resistance to opportunity. As in some individuals it is measured by a very moderate answer to an open, 'what is there in it for me,' so in others it has often proved beyond human power to measure.

As different forms of temptation vary in strength for different personalities, it is well to inquire into different phases of honorableness. The simplest one is of reliability in money matters, for here the issues are as a rule the most clearly defined. An important line of approach is also the extent to which agreements or promises are held to, even under difficulties; some keeping them to the last letter, others making them without due consideration if they will be able to keep them, some easily seeking reasons for not keeping them, or even making promises with the intention of evading them. Closely related to this is the broad question of conscientiousness in the performance of duty, the general sense of responsibility, within normal limits a necessary social quality, but in excess sometimes a burden to its possessor. It seems also that there is a morbid scrupulousness, or tendency to be blocked in action by considerations of a purely formal character, that is not of positive, but of negative moral implication, compensating for dereliction in large things by scrupulosity in more trivial ones.¹ And it is perhaps not out of place to assign a moral value to the quality of discretion, as 'the kind of honesty that keeps a man's mouth shut when he hadn't ought to be talking,' certain persons on the other hand being unable to keep confidences or yielding with marked readiness to the insidious satisfactions of ill-advised gossip, wanton traductions of character and the like. Dynamically, however, it seems rather different from the other topics. See table opposite page.

A considerable share of human activity is determined, or at least modified, not with direct reference to the struggle for existence, but with reference to certain immediate satisfactions involved. These are essentially the recreative activities, and derive their import, as reflections of the personality, through being chosen with relative freedom from a large number of alternatives, representing all varieties of activity. Their import is limited by the fact that in all but the leisure class, recreative activity may be largely a derivative of the work done for a living, selected precisely for its

¹ "Du sollst nicht auf meinen Mann schimpfen, Arthur! Ernährt er mich nicht?"

VII. RECREATIVE ACTIVITIES

To What Degree Are the Following Indulged In	A	B	C	D	E
Sports requiring quick and continuous action (tennis, motor-driving, sailing, etc.)	+!	+	+?	+	+!
Less active sports (golf, automobile riding, billiards, walking, etc.)	+	-	-?	-!	-
Hunting or fishing	-	-	-	-!	-
Camp-life in general	-	-	+	-!	+
Games of intellectual character (whist, chess)	-	+	+	-!	-
Games of less intellectual character (backgammon, hearts, casino)	-	-!	-	-!	-
Gambling or wagers	-	-!	-	-!	-!
Alcohol	-!	-?	-	-!	-!
Tobacco	-!	-!	+?	-!	-!
Other drugs	X	X	X	X	X
Reading	-	+	-	-?	-
Music	-	-	+?	-	+!
Pictures	+!	+?	+?	-	-
Artistic creations	X	X	X	X	-
Delicacies in eating or drinking	+!	-!	-	+	-
Sports involving physical danger	-	-	-	-!	-

H.-A.	H.-W.	C.	T.-B.
In his play as a child, what did he prefer? Did he exercise much imagination ¹ in it?	Fond of amusements outside home Intellectual games Games of chance Sports Fads (sociological) Collections Read much Fond of children Fond of animals Drinking Eating Occupy leisure Change-loving or fixed habit Old memories		Love of beauty Knowledge <i>vs.</i> lack of intellectual interests Reading Mathematics Music-rhythm Dancing Painting Exploration Eating Tobacco Alcohol Narcotics Money-getting Money-hoarding Gambling Athletics Chess.

relation to the more fundamental activity. Thus a tendency to the more sensuous forms of recreation is frequently seen among persons of great practical energy and accomplishment. Again, the wild life may be sought for the pure sport of contest with nature, or it may represent a trend towards aloofness from social contacts that are distasteful. One does not, therefore, treat the avocations as fundamental, but as supplements or compensations to vocational activity, with account of the different mental mechanisms that may lie behind them.

¹ Italics mine.—F.L.W.

The enumeration of the varieties of recreative activity occupies a large share of the Heymans-Wiersma inquiry, the 'Trait-Book,' and some other schemata. Above it has been endeavored to modify these lists in accordance with what seem to be the essential differences between the types. We have to distinguish those recreations which depend primarily on motor adjustments, those depending primarily on intellectual adjustments, and those of a more directly sensuous character. Motor sports vary according as they demand rapid and more or less continuous adjustments, as tennis contrasted with billiards. The tendency towards the open air life should also be inquired into, and whether this is sought for its own sake, or for such secondary opportunities as hunting or fishing. The main line of cleavage in the intellectual pastimes is the complexity of the adjustments they involve, in which there is a fairly well-defined scale with chess and the whist group at one end, hearts, casino and the like, on the other.

In the sensuous group we usually consider music and art the more elevated, alcohol and drugs the more degraded.¹ In the course of the inquiry it will be well to note whether there is special tendency towards or avoidance of recreations that involve the element of competition. Here also belongs a question as to whether the pastime is followed for its own sake, whether it requires the additional stimulus of a wager, or whether the wager is itself the more fundamental thing. If a form of recreation is preferred that involves special danger, this too may throw a valuable sidelight on character.

Abstractly speaking, there would be no great disagreement about the relative value of these different recreations from the standpoint of mental hygiene. It is a banal observation that activity is better than passivity, and those which make the more real demands for adjustment to the outer world are accordingly to be preferred above those which do not; playing games that is, in contrast to watching them, reading, or listening to music. It appears that the mental value of these adjustments is indeed largely proportional to the motor

¹ Cf. also the sexual sphere, p. 324.

element they involve; billiards, bowling, tennis, for example, as opposed to card games. As pointed out, however, the recreative activities may be determined in too many ways to be an unequivocal index to the quality of mental balance. Their status is like that of the catalepsy which no one would overlook as a symptom, but no one would base a diagnosis upon.

VIII. GENERAL CAST OF MOOD

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
How cheerful.....	-	+!	-	-	+
How stable.....	+	+?	+	+	-!
How deep.....	+?	-	-	-?	+
H.-A.	H.-W.	C.	T.-B.		
Does he get despondent without apparent reason?	Emotional (easily affe- ctable)	Emotion Intensity	Ludicrousness <i>vs.</i> ab- sence of sense of humor		
Does he seem to enjoy his discomforts?	Happy or depressed	Cheerfulness	Anger <i>vs.</i> unruffledness		
When anxious what is his reaction?	Fearful		Elation <i>vs.</i> depression		
Has his mood apparently been permanently influenced by any special occurrence or circumstance?	Easily consoled		Earnestness <i>vs.</i> frivolity		
Did he have tantrums when a child?			Alternating mood <i>vs.</i> constancy		

In dynamic considerations of the personality, the paramount rôle has been usually assigned to affectivity, especially by those who most closely observe the personality as such. We have to consider whether the affective life is manifested in ways beneficial or detrimental to the personality, and in what special processes it so manifests itself. Among the essentials of a perfectly balanced personality are that its acts shall accord with experience rather than with a contrary feeling, that it shall react to situations objectively rather than to their personal implications, that its aspirations shall be within and in accord with its capabilities, that its power of judgment shall not be impaired in crises of danger, or the incidence of good or evil fortune, and that there shall be no conflict between morals and conduct. The above traits have an important common factor in the affective sphere.

In the ill-balanced personality we find essential disharmonies between the affective reactions and those of the proper objective value. We find a behavior determined largely upon subjective grounds, by mechanisms akin to Bleuler's *autism*; a disturbance of the reaction's adequacy through being associated with abnormal affective states.

The examination of the individual's affective reactions begins with the inquiry into the fundamental affective basis of his reactions, the mood. The three directions which it takes are readily understood. First its reference to the pleasantness-unpleasantness scale, as represented by the *elation vs. depression* of the 'Trait-Book,' or the *Cheerfulness* of Cattell.¹

The necessary relationship between this factor and the eternal circumstances is of course very slight. Either extreme is included in the pathological, as the constitutional excitement or depression. But the individual's mood is subject to fluctuations, so that its constancy or stability must also be ascertained; marked fluctuations may here also be quite independent of the external situation. Another feature of mood is that recognized by Cattell as *Intensity*, by Davenport as *earnestness vs. frivolity*. While this is an attribute usually viewed with respect from the social standpoint, it is often a prolific source of difficulties for the individual. "The world is a comedy to those who think, a tragedy to those who feel." And whoever feels the world as a tragedy, accomplishes the less to make it otherwise for his neighbor. Depth of feeling is apt to be associated with depression of feeling, just as in Kraepelin's phrase, the depressive emotions, as of fear, worry, despair, anger, and the like, provoke much intenser reactions than the greatest of joyful emotions, which rapidly subside into a placid sentiment of happiness assured.

Another brief but important section, within whose scope there is substantial agreement within the different schemata.

¹ This is one of the topics where it is especially important to remember that the average does not represent the midpoint of the scale or anything near it, because the regular and normal human mood is one of positive contentment with existence—not indifference towards it.

IX. ATTITUDE TOWARDS SELF

	A	B	C	D	E
How self-conscious.....	+	-	+!	+	-
How conceited.....	+	+?	-	+?	-
How patient, capacity to 'endure to the end'.....	-	-	+	+!	+
Demand for self-justification.....	x	x	x	x	+!

H.-A.	H.-W.	C.	T.-B.
Is he self-reliant or self-deprecatory (Feeling of inferiority)?	Obstinate in opinions Self-satisfied Talk of self	Unselfishness	Conceit <i>vs.</i> humility Self-confidence (in judgments)
How dependent is he for his comfort on the opinion others have of him	Concerned for present or future		Patience <i>vs.</i> impatience
Is he conceited—egotistic—given to self-admiration?			
Is he inclined to pay much attention to his aches and pains?			

Foremost the question of self-consciousness, here asked of as a whole, but whose manifestations, as with other topics, are checked and rechecked through various succeeding rubrics. Easily comprehensible are the difficulties to which its excess exposes the personality, in the brooding over personal inclinations and wishes, over the consideration due from one's fellows, and the continual self-comparison with them. "There is too much ego in his cosmos." In view of the great importance of self-consciousness to personality, it may not be amiss to remark that it is among the very few of the present traits which seem now in fair degree open to experimental approach—through the methods of free association. The term *self-consciousness* is sometimes in a loose way used synonymously with diffidence, though a little reflection readily shows that, as in the character of Mr. Peter Magnus, self-consciousness is quite as truly an accompaniment of conceit. A self-conscious person may be either, largely according to the mood, extreme self-consciousness merely tending towards extremes in one or the other of these directions. One must therefore inquire separately regarding the tendency to self-esteem, self-confidence, or the 'feeling of inferiority.' And we here again observe what we observed

with the mood, that the normal, healthy estimate of self is not an indifferent one, but is distinctly on the side of a good opinion of self, together with cheerfulness of mood. Natural selection would probably tend to develop such attitudes, though the feelings of humility and unworthiness have proved by no means without their psycho-biological function. What was noted in an active sense as *persistence* is here included in the passive sense as *patience*, the ability (*resp.* tendency) to sacrifice the present for the future, to endure unto the end, to 'to wait till the sights come on, and then fire.' It is a simple and well-defined quality, expressly provided for in all the longer schemata.

X. ATTITUDE TOWARDS OTHERS

	A	B	C	D	E
How sympathetic	+	-?	+?	-	+
How generous	+	+	+?	-	+
How critical	+	+	-	+	?
How jealous	+	-	-	+	-!
How sensitive	+!	-	+!	+!	+!
How forgiving	+?	-	-	-	-?
How able to judge others	+!	+?	-?	-	-

H.-A.	H.-W.	C.	T.-B.
Does he keep friends long or does he give them up on slight provocation?	Sensitive Fault finding Suspicious Tolerant (of opinions)	Kindliness	Contemptuousness <i>vs.</i> respectfulness
Is he sentimental in his friendships?	Easily reconcilable		Sensitiveness
What qualities in others attract him?	Sympathetic Judge of persons		Trustfulness <i>vs.</i> suspiciousness
Does he show any marked preference for or great dependence on any member of the family, or marked antagonism?			Gratefulness <i>vs.</i> ungratefulness
Has there been any change in this respect between childhood and adult life?			Considerateness <i>vs.</i> inconsiderateness Self-sacrifice <i>vs.</i> selfishness

The import of most of these topics is self-evident. *Sympathy* ranges to the other extreme of pleasure in the misfortunes of others. The character of sympathy must also be considered in relation to its objects. It has been aptly

pointed out that an excess of sympathy for animal suffering is often associated with the absence of, is indeed a compensation for, similar feelings towards humanity. Heymans and Wiersma are careful to make this distinction in their questionnaire. As elsewhere, it must be borne in mind that sympathy, also generosity, are favorable qualities within certain limits only, and the extreme grades be allowed to indicate their presence "to a fault." Generosity must not be figured in material terms only, but as a general opposite of "closeness"; measured in the amount of sacrifice. The term *critical* is used in its restricted meaning, to denote the general readiness to take external situations at their face value, as in business relations. The question is whether the individual fundamentally tends to be suspicious, critical (demanding to be 'shown'), trusting, or naïve. Jealousy may be considered the opposite of tolerance, to be estimated upon the ordinary basis of jealousy of one's own opinions, friendships, or in various social relations. Its presence in extreme degree recognizedly predisposes to difficulties in social adaptation, in fact its extreme absence may sometimes be easier for the individual, though it too may prejudice his position in the external world. Sensitiveness, to an abnormal degree, is a quality that figures largely in delineations of psychopathic personalities. Its part in Ribot's classification of temperaments will be remembered, and it was most significant that 'active' should have been chosen to represent its opposite. It is measured by the intensity of affective reaction to the given situation, its extreme being seen in violent fluctuations from euphoria to anger or despondency upon trivial or even imaginary occasions, as well as exaggerated but often ephemeral and unproductive reactions of pity, enmity or the like, as contrasted with indifference or apathy. Objectively, its most unfavorable result in the individual is the seclusion in which he may seek to escape the emotional shocks to which ordinary life exposes him, the withdrawal into self from the world of concrete aspiration and accomplishment.

The quality of forgiveness, or the general reaction to injuries, is perhaps a little complicated to deal with in a single

topic. None better illustrates the distinction in the above mentioned 'social' and 'individual' viewpoints in the study of the personality. From a social standpoint one's essential concern is how much revengeful reaction we shall find in a person; does he attempt to give evil for evil, or not? We regularly rate the latter course as the higher one. Mental hygiene also, is concerned with the individual's capacity for 'getting square'—not with one's enemy, however, but with one's self. This may occur, according to the personality, either through requiting an injury (*abreagieren!*) or through forgiving it. While it is proper to ascertain which of these adjustments the individual is inclined to, and the latter may well be regarded as ethically higher than the former, neither are means which are mentally unfavorable to the personality, *so long as the feeling of injury is given up*. The attitude of forgiveness will not of course be confounded with the mere abstention from vengeance, which may be conditioned by incapacity or by fear. Here is seen the morbid reaction to injuries, in the form of nursed grudges, cherished, but never productive resentment. We thus have first the external question of whether one adjusts his injuries through revenge or forgiveness, and then the fundamental one of how far he is able to adjust them by either of these means at all. The latter is much the more important in all questions of mental balance. It might also be inquired whether the reaction to mental injuries (slights, insults) is especially marked in comparison to material ones, as indicating a temperament of exaggerated subjectivity. Material injuries are also more capable of objective adjustment (restitution).

Of special significance also is the ability to judge others (independently of social experience), taken direct from the Heymans-Wiersma series. It is one of those specific questions included because of secondary interpretations it makes possible. It is distinct from the above mentioned quality of criticism in that there is meant the general readiness to accept, while here is meant the capacity to understand the factors that make for acceptability. To understand the personality of others, one must freely recognize his own, and the indi-

vidual who continually suspects where he should trust, and trusts where he should suspect, does so because he sees others through the distorting glasses of unacknowledged self.

XI. REACTIONS TO ATTITUDE TOWARDS SELF AND OTHERS

	A	B	C	D	E
How scrupulous of personal appearance	+	+	-?	+	+
How sociable	+	+!	-!	-	+
How socially forward	-	+	-!	-!	-?
How demonstrative of emotion	+	-	+?	-!	-
What tendency to unburden	-	-	-!	-!	-
How great a demand for sympathy	-	-!	-	-	-
How much inclination to self-pity	-	-?	+	+!	-
How much pleasure in the success and enjoyment of others	+	+	-	-?	+
How much of a 'good loser'	+	+	+	-?	+
How much given to witticisms, epigrams, etc.	-	+?	+	-	-
What tendency to emphasize the good side of the environment	+	+	+?	-	+?
How even-natured (temper)	-?	+	+?	+!	+

H.-A.]	H.-W.	C. f	T.-B.
Does he have many friends or is he whimsical in making friends?	Vain Change friendships Witticisms	-	Love of sympathy Vanity
If he prefers to be alone, how does he rationalize this? Are there special circumstances under which he goes away by himself, e.g. when reprimanded, criticized, or when something is required of him?	Natural manner Associate with inferiors Different manner towards superiors and inferiors Flatterer		Benevolence <i>vs.</i> malevolence Enviousness <i>vs.</i> unenviousness
Does he blame others for his faults?	Well informed about neighbors		Openness <i>vs.</i> secretiveness
Is he apt to blame others for his own mistakes?	Miserly		Forwardness <i>vs.</i> bashfulness
If reticent, is he reticent generally, or in relation to certain topics?			Avarice <i>vs.</i> prodigality
Is he more frank to certain people?			Wittiness <i>vs.</i> dullness
How does he react to pleasure, good news, success? (Description of reaction.)			Frankness <i>vs.</i> closeness
How does he react to real trouble, such as bereavement, failure or success (<i>sic</i>), responsibility? (Description of reaction.)			Gregariousness <i>vs.</i> seclusiveness
Does he make attempts to overcome his despondency or worrying?			
What was his reaction to the death of any member of the family?			
Is there any special tendency to cruelty, plaguing, tantalizing?			

Under this heading are brought together a number of topics that are largely functions of the two preceding sections, but which afford the opportunity to put the inquiries in a more specific and searching form. The range from foppishness or finickiness in appearance, habits or personal requirements to that of extreme slovenliness is first mentioned. Finickiness and the like in superficial things is sometimes of import as the compensation of laxness in deeper ones. The fondness for society, tendency to seek it or avoid it, is a feature whose essential character it is needless to dwell upon, and which should be most carefully dealt with. It may, of course, be motivated in different ways; Heymans and Wiersma particularize to know if the society of superiors or inferiors is preferred. Two closely related questions are first, that of the tendency to *talk* freely to intimates of one's difficulties (not necessarily to take advice), as opposed to bottling up and attempting to deal with the situation alone. Second, the tendency to freely exhibit one's *feelings*, or to keep them to one's self, to the extent perhaps of dissimulation, *belle indifference*. As also in the 'Trait-Book,' the distinction is made between the above simple fondness for society or aversion to it (*gregariousness vs. seclusiveness*), and the tendency to forwardness or bashfulness in social relations; this again is worthy of especially careful inquiry. We also distinguish from the simple tendency to talk of one's affairs, that of an active craving for sympathy and reassurance in them; some persons requiring to tell their troubles, but quickly resenting sympathy in them.

"Are you weak enough," Monte Cristo asked of Morrel, "to pride yourself upon your sufferings?" The tendency to self-pity is a characteristic reaction whose essentially morbid quality is well recognized in the popular mind, and a high value is placed upon exceptional freedom from it,

Not with an outcry to Allah nor any complaining,
He answered his name at the muster and stood to the chaining. . . .

Especially important questions are those dealing with the attitude towards the success and happiness, or the disappointments and failures of others. No one will get much

from life who dislikes to see others get more; and this reaction, often exquisitely shown in the intolerance of innocent amusements,¹ or a feeling of opposition on hearing others well spoken of, is not without its far-reaching consequences—or correlates—in the individual's outlook on existence. On the other hand, the capacity to provide for the enjoyment and well-being of others is generally regarded as a chief essential in the durable satisfactions of life.

One may get reliable information of a specific tendency to speak well or ill of one's surroundings. The former is an obvious evidence of better adaptation to the environment, if only on the metabolic level, that spares directly many minor difficulties. As a phase of this too may be noted whether the individual inclines to attribute good or bad motives to the actions of others, particularly if inclined to the latter. Still further in this field, the quality of a *good loser* is one that looms high in everyday estimation, with unquestionable reason. The conception is so definite in the mind of every one that it should easily prove one of the most useful topics in the series; as a popular measure of character, it probably outranks every other one. The quality is of course the greater, the greater reverses are met without mental flinching, and has its morbid converse in those who do not tolerate defeat in even minor sports, games, etc., in which they have no claim to superior ability, without the most ill-concealed evidences of discomfiture.

The tendency to minor clevernesses, repartee, jokes and the like, is one that receives attention in most detailed schemata. To treat this characteristic as an outcrop of fundamental cheerfulness of mood is an error against which it should not be necessary to caution at great length. Happiness expresses itself more spontaneously, and at lower levels. Wit and especially epigram are in the well-balanced personality the mere playthings of acute intellect. But to other and

¹ "We know the man," remarked the captors of Gabriel Grub, "with the sulky face and the grim scowl, that came down the street to-night, throwing his evil looks at the children, and grasping his burying spade the tighter. We know the man who struck the boy in the envious malice of his heart, because the boy could be merry, and he could not. . . ."

equally distinct personalities these things have a more essential relation, and serve the function of a 'cavalry screen' behind which deeper and less exhibitable trends of the personality are hidden. In those whom one knows well, one sees this mechanism quite too often to doubt its reality or interpretation. It is one of the less objective ways that the organism takes for the social adjustment of its difficulties.

XII. POSITION TOWARDS REALITY

		A	B	C	D	E
What capacity to take things as they are		+?	+	+	-	-
What capacity to acknowledge mistakes or transgressions ..		+?	-	+	-!	+
How practical		+?	-?	-	+	+
How influenced in action by likes and dislikes		+	+?	-?	+	-
What tendency to day-dreaming		-	-	-	-	+
H.-A.	H.-W.	C.	T.-B.			
Practical	Judgment Reasonableness		Phantastic Objectiveness <i>vs.</i> introspective- ness. Opinionatedness <i>vs.</i> diffidence			

This has been made perhaps the most important and inclusive of the divisions. "We may," writes Professor Cattell, "imagine a world of Arabian Nights, or of Arthurian knights, or of metaphysical twilight, but those who should act as though they lived in such worlds would find themselves in those parts of the real world known as . . ." Still, the author of this passage should be among the last to draw a sharp line here. All of us live to some extent, be it ever so little, in such worlds; and to the extent to which we place our activities with the real world will it "continue to honor the drafts that we draw upon it."

In the broad way in which it is conceived of here, position towards reality may be treated at many different levels. We may consider at the most superficial level, the way in which a number of individually trivial reactions are affected by the personal factor of like and dislike. The common factor in these topics is the ability to react in accordance with a 'pragmatic' reality, against inclination. When this latter is out of harmony with the wisest and most reasonable course,

the extent to which behavior is deflected by it is a measure of inadequate adjustment to reality. This phase of the function corresponds to what is ordinarily included under 'self-control.' It may be seen in the simplest passages of life. To read an interesting book in a bad light, to deliberately overeat of favorite dishes, to pursue favorite sport to exhaustion, or when convalescing from illness, before one's strength is suited to it, or any other voluntary sacrifice of physiological well-being to immediate pleasure, are among the ways in which faulty adjustment to reality manifests itself at this level. In general, how much does the individual's competence in a task depend upon his liking for it?

And how able is he to squarely face situations he does not like? The *paradigma* for this phase of the topic is familiar to all. The fox did not acknowledge the actual inaccessibility of the grapes, but salved his *amour propre* by persuading himself that they were sour; with the result that when he finally came to some that he might have reached, he had so firmly convinced himself of their generally inedible quality that he again let them go and missed his dinner altogether.

A similar process obtains in the intellectual sphere. To what extent are the individual's opinions really matters of (subjective) policy rather than of creed? To what extent does he see his mistakes and acknowledge them, or strike an attitude on a question and then hang to it, shutting the eyes to contrary indications? The 'mechanism of wishfulfilment' is a banality. Cæsar long since remarked the willingness of men to believe what they wish, making sound military use of it; and he is always a rare thinker who pursues his interests to their ultimate conclusion without some intellectual sacrifice upon the altar of the god of things as he thinks they ought to be.

The inability to acknowledge mistakes is of a piece with the inability to acknowledge transgressions of moral principle. The allegation of false motives for conduct is an elementary feature of hypocrisy, but one must not neglect its further rôle in mental adjustment by self-deception. This is the mechanism implicit in *qui s'excuse, s'accuse*. One individual may

do wrong directly, in response to overmastering organic or social impulse, going down before a temptation as Greek before Greek, in frank recognition of a situation beyond his strength. A less robust type of nature reacts by persuading itself that the involved action is right. It is this process which is seen in such rationalizations as the 'higher law,' the 'larger good,' 'affinity,' 'Sichausleben' and the like. "All is fair in love and war," that is, everything is fair to get what you want badly enough. Such expressions are essentially reactions of self-justification, in natures able neither to avoid the sense of wrong-doing nor to endure it. How great is this demand for self-justification? Is it so great that the individual lies to himself in order to obtain it? It is impossible to count on 'unlimited elasticity,' as Adolf Meyer puts it, in the use of such mental adjustments as these. Occasionally, when a sudden stress of circumstance drives home an issue habitually evaded in these ways, flurries of an altogether psychotic nature result. Or there may be a gradual, but none the less morbid detachment from the external situation, and the 'substitution' of imagined ones.

Day-dreaming is not necessarily a pernicious mechanism. August Hoch points out that in this way, especially in early life, ideals and aspirations may take form that have an important and salutary influence in giving shape to the activity of later years. In various occupations, as the writing of fiction, one must put imagination to continued and systematic use, but it is not clear that this necessarily impairs capacity for the world of affairs. The process may however go much deeper, especially in the presence of a power of vivid imagery, as the Germans have it, *Einbildungskraft*, which gives to the imagined situations a degree of satisfying power that lends itself readily to gravest abuse. We thus direct special inquiry to the tendency to *unproductive* day-dreaming, systematized flights of fancy, in any direction. The detachment from the real world that arises from living in a world of imaginings, the continued recourse to this mental 'Easiest Way' to gratify ambition or longings, sooner or later brings about a considerable dependence on them for this purpose,

breaking up both desire and capacity for adequate reaction to external things.

The process is one well recognized in the psychopathic personalities. In an especially well-drawn picture of such a degenerative condition Kraepelin remarks:

"The imagery possesses great sensuous vividness, and forms ready associations. In consequence there easily develops an abnormal tendency to fantasies. Many love to paint for themselves imaginary situations and adventures in the smallest details, and take pleasure in assuming the rôles of princes and heroes at an age when this childish habit has regularly long since vanished."

And Birnbaum, again, voices the matter more abstractly:

"Since, indeed, in the normal (personality), the kind, content and direction of thought are essentially influenced by affective factors, so also in these natures are aroused especially those ideas which are in harmony with the needs of an over-developed emotional life; *i. e.*, unreal plays on thought and structures of fancy, to the exclusion of the unsatisfying ideas that accord with reality. To this is added an incoördinate distribution of the proper affective elements; intensively pleasurable feelings in flights and images of fancy, incomplete and pleasure-lacking feelings in the sphere of intellection and experience. All this is the expression in these cases of the predominance of imagination (*Einbildungskraft*) as opposed to logical and critical thinking."

The psychogenic interpretation of dementia *præcox* has proceeded essentially through this mechanism. "What," asks August Hoch, "is after all, the deterioration in dementia *præcox* if not the expression of the constitutional tendencies in their extreme form, a shutting out of the outside world, a deterioration of interest in the environment, a living in a world apart?"

The position towards reality then, depends upon the co-ordination of affect and proper reaction. It is adequate to the extent that proper external reaction is not sacrificed to internal personal feeling.

XIII. SEXUAL SPHERE

	A	B	C	D	E
How forward towards the opposite sex	+	?		-	-
How freely speak with intimates of own relation to question	-	-	-	-	-!
What is the prominence of the following sexual reactions:					
Normal intercourse	-	-?	-	-!	-!
Flirtation, love affairs, 'spooning,' etc.	-	-?	-?	-!	-!
Sexual trends in reading, art, conversation	-	-	-	-!	-
Masturbation and allied practises, sexual imagination	-	-	-	-!	+
Negativistic reaction (prudishness)	+	-?	-	+	-?
What degree of contentment with existing sexual adjustments	+	+	+	+	-
How dominant in sexual relationships	+	+	-?	-	-

H.-A.	H.-W.	C.	T.-B.
Is his personal attitude in harmony with his own sex (Tom-boy, sissy, mother's boy, mannish, effeminate)?	Promiscuous or continent	-	Sex indulgence
Is he attracted by older or younger persons of the opposite sex?	Obscene or sexual witticisms		Philoprogenitiveness
When love affairs were broken off, what was the reason?			Constancy <i>vs.</i> fickleness
What was the reaction to disappointments in love?			Amorousness <i>vs.</i> frigidity
Was he decided or wavering when the question of engagement or marriage came up?			Chasity (<i>sic</i>) <i>vs.</i> licentiousness
In marriage or other similar relationships, what is the attitude toward the partner?			Innocence <i>vs.</i> impurity
Is there, or is there not, a desire for children?			Sex perversion
Are there any perversions?			
Are there any idiosyncrasies towards food or odors?			

The same adaptive mechanisms that we have been discussing for the personality in general are met with on a more limited scale, but with much clearer definition, in the circumscribed sphere of sexual activity. In the amount and character of these reactions in the individual, the general feature of bashfulness or forwardness towards the opposite sex is first to be noted. But it is impossible to rightly judge the quality of sexual adaptation simply from the gross degree of sexual reaction. A habit of reaction may well meet the demands of one organism that would be quite inadequate to the balance of another. Some light must be thrown on the subjective contentment with the types of adjustment em-

ployed. Natures not content with their adjustments have thus far failed of adaptation, while those superficially content with inadequate adjustments give evidence of fundamental lack of adaptability in an objective sense. Some stress should be laid on the individual's capacity to talk sincerely of the subject with closest associates. This of course applies to the question only as it affects the individual himself, in no way to the mere habit of speaking along related lines. A further indication of subjective attitude is given in the expressed motivation of any absence of sexual reaction, whether on moral grounds, hygienic ones, or otherwise, and the consistency of this motivation with actual conduct.

Next is to be seen what use the individual makes of the more special types of adjustment. First, the extent to which the impulse is carried to normal conclusion, a matter that can be very concretely dealt with. One should know if sexual intercourse has been absent (-!), restricted to marriage (-), not so restricted (waywardness, 'wild oats'), (+) or especially promiscuous (+!). What use is also made of other, equally natural, but less conclusive ways of reaction, ranging through the ordinary social contacts, flirtations, 'spooning,' love affairs and the like. This is a very wide field, including most of the normal adjustments that are open to many persons under existing social and biological conditions. It is a general experience that the best safeguard against difficulties of all sorts in this sphere is the association with healthy-minded individuals of the opposite sex. But there are further, less adequate adjustments in the form of sexual trends in language, art, and the like, also the whole group of autoerotic manifestations, ranging from the most casual bits of day-dreaming to habitual masturbation, psychic or otherwise. A widespread shrinking from sexual reactions seems to have a good deal the same psychobiological foundation as the wearing of clothes, and as little of a pathological character. But, like the autoerotic reactions, it takes on a morbid character when it becomes an end in itself, replacing the trends that lead to more social means of adjustment. In this form we know it as *prudishness*, which may be the expression of

great personal resistances or ill-faced lack of opportunity, and also a process to

Compound for sins we're most inclin'd to
By damning those we have no mind to,

which pays in autoerotic coin the blackmail that instinct exacts from weakness for the pretense of virtue.

The purpose of such inquiries is to give the best possible insight into the individual's sexual adjustments, and whether their hygiene is good or bad. In determining this it must be remembered that for the individual the standards of psychosexual hygiene in terms of conduct are not absolute. The wide individual differences in sexual constitution make it impossible to generalize. Different communities have different and sometimes very precise standards of conduct in this respect, but they are always social standards, and there are always some individuals who are incapable of adaptation to them. If such standards are genuine and rigidly adhered to such unadaptable individuals tend to disappear, but if the standards are grounded in hypocrisy and readily departed from, then they will multiply and create more or less serious social problems. Contemporarily, social evolution has outstripped biological, and the genuine requirements of psychosexual hygiene are in certain individuals not compatible with the genuine interests of their community. This is what makes the tremendous difficulty of guiding the *vita sexualis* of a neurotic personality between the Scylla of promiscuity and the Charybdis of abnormal fixations.

XIV. BALANCING FACTORS

	A	B	C	D	E
How firm in religious beliefs	+	-	-	-	+
How active in church work	-	-	-	-	-
How intense interests or fads other than already dealt with	+!	+?	-	-	-
To what extent are ideals expressed	+?	+?	+?	-	+
How much are they in harmony with actual trends	+	+	+	+	+
How adequate a balance is the final result of these means	+!	+	-?	-	-
H.-A.	H.-W.	C.	T.-B.		
Is he superstitious?	Religious Active philanthropy Conduct consistent Great schemes	-	Religiousness vs. unreligiousness		

The final division of *balancing factors* is based upon the interpretation of certain activities as compensations for hindrances that the personality encounters to behavior in ways most natural or agreeable to it. As we saw, our basal question is that of mental *balance*; what then, is the demand for special balancing material, how great and how salutary a part does it play in the makeup. Practically all activities in pursuit of immediate pleasure may have a balancing function, perhaps an extreme one, though the indulgence of these does not ordinarily transcend the demands of recreation. Such activity as of itself sufficiently absorbs the attention will always serve to divert the attention from, and to that degree adjust, or 'balance,' difficulties or troubles. The 'lowest-level' phase of the balancing mechanism is seen here in very special activities taken up in the conscious effort to 'get away' from definite, unpleasant mental situations. The relative effectiveness in this direction of different sports, amusements, etc., is an interesting study for itself, besides which

Es ist ein Brauch von Alters her,
Wer Sorgen hat, hat auch Likör,

and certain repeatedly ineffective sexual reactions often observed in psychopathic individuals appear also to belong here.

When, through circumstance and temperament, the personality is blocked in the pursuit of fundamental instincts or wishes, a most characteristic reaction is to cultivate some other, more realizable interest with the same ardor as attached to the former trend, and to endow it, so far as imagination will permit, with the same value for the personality that the former trend would have had, could it have found expression in the individual's life ('Substitutive Reactions'). The inordinate faddish pursuit of special interests, quite independent of, and out of proportion to their objective return, is sometimes only too obviously the reaction to more fundamental trends which can be only incompletely lived out. This seems particularly the case with interests in opposition to prevailing social tendencies, as for example, the propaganda for anti-vivisection.¹

¹ Cf. Dana, 'The Zoophil-Psychosis,' *Medical Record*, March 6, 1909.

Mental adaptation through altered sense of values is seen in its fullest development on a far higher level, in the 'balancing factor' of human nature *par excellence* and for all time; that of faith exemplified in religion. While the earliest beliefs arose presumably as interpretations of natural phenomena, with only secondary moral application, it is difficult to avoid the conclusion that those religions have been the most successful which have performed the highest *balancing* function, in subordinating matters of cosmogony or meteorology to the more intimate needs of psychic life. Mental difficulties in all fields are lessened by a belief in ultimate happiness or 'justice,' in the hope perhaps of torment for one's enemies, by glorifying earthly suffering and abasement, minimizing material comfort and distinction. It is a general observation that religious faith is less important to those to whom life presents few difficulties; thus exclaims the psalmist, "*Because they have no changes, therefore they fear not God.*" The direct effects of religious ceremonial are not unimportant. The question is, however, not simply one of how great a part religion plays in the makeup, but rather of the extent to which religious faith and activity have in the individual a balancing function, are the response to failures of adjustment in other fields. Special educational conditions may produce much religious fervor that is not of a compensatory character, and has no relation to difficulties. A gradual growth of religious interests in relative maturity, or a religious conversion, are more significant in this direction, indicating a situation insufficiently compensated by the existing mechanisms of adjustment, for which a more adequate compensation is sought in the newer interest.

As we should expect, a mentally hygienic religion demands expression in conduct, faith justified by works. The pathological manifestations we see in excessive preoccupation with dogma that either inhibits activity, or distorts it into bizarre forms.

The essential thing to note is the adaptive nature of religious elements in our reactions. The consequent inquiries are first, how much of an attempt is made in this direction.

Second, what kind of an attempt is it, whether one of a broad-based faith and hope, or one of hair-splitting niceties of creed, ritual and symbolism; one productive of good or evil in the attitude towards others. And last, how successful is the attempt, how much of value these factors really contribute to the mental balance that the individual maintains.

The idealizing process is a more general phase of the same altered sense of values, and the objects that we endow with the highest value we term ideals. They assume a subjective value beyond that which they have for the individual's relation to the external world. An ideal may be regarded as primary or genuine when it is in harmony with a fundamental instinct-trend of the personality that holds it. Ideals of home, of work, of wealth and influence are usually of this nature. A secondary or false ideal is one which is opposed to the fundamental instinct-trends, and is derived through an effort to heighten the value of suppressing them, as determined through circumstance and temperament.

A primary, genuine ideal performs its balancing function in extreme valuation of a fundamental trend, such as the maternal instinct, to compensate for inferior social position, neglect by, or loss of, the husband; or again, the idealization of certain kinds of work to compensate for economic sacrifices they involve.¹ These are, as a rule, the more favorable,

¹ A most exquisite literary expression of this 'adaptive alteration of values' is found in Gogol's 'The Cloak' (tr. I. F. Hapgood), as follows:

It would be difficult to find another man who lived so entirely for his duties. It is saying but little to say that he served with zeal: no, he served with love. In that copying, he saw a varied and agreeable world. Enjoyment was written on his face: some letters were favorites with him; and when he encountered them, he became unlike himself; he smiled and winked, and assisted with his lips, so that it seemed as though each letter might be read in his face, as his pen traced it. . . . Having written to his heart's content, he lay down to sleep, smiling at the thought of the coming day,—of what God might send to copy on the morrow. Thus flowed on the peaceful life of the man, who, with a salary of four hundred rubles, understood how to be content with his fate; and thus it would have continued to flow on, perhaps, to extreme old age were there not various ills sown along the path of life for titular councillors as well as for private, actual, court, and every other species of councillor, even for those who never give any advice, or take any themselves.

. . . But he made up for it by treating himself in spirit, bearing ever in mind the thought of his future cloak. From that time forth, his existence seemed to become, in some way, fuller, as if he were married, as if some other man lived in him, as if he were

healthier adjustments in this sphere, because based on things that regularly do have positive and high value for the personality. The less favorable means of dealing with the difficulty are to dodge the existence of the obstructed trend by idealizing its opposite. This creates a secondary ideal, out of harmony with the real tendencies of the personality, to be, as one epigrammatist put it, a 'mirage of failure.' An ideal of temperance is false if it arises from an incapacity for indulgence; an ideal for poverty is false if grounded in the inability to accumulate wealth; an ideal of chastity is false if but the response to failure of sexual adaptation. The concrete results of such mental habits are only partially understood. General embitterment may ensue if the illusions are lost after having committed the individual to existence limited by them. Needless self-accusation may result from the personality's reassessments of itself in the face of standards it has falsely assumed. But it is also clear that the symptomatology of mental disease can be described, in no small part, in terms of such mechanisms as these.¹

In the observation of the personality first account is taken of the general tendency of the individual to idealize. The normally satisfied personality probably has little tendency to idealize, and one does not meet with it save in the presence of corresponding difficulties in mental adjustment. As means of compensating for difficulties, it must be ascertained if the trends idealized are genuine, or out of harmony with the underlying nature of the individual. The former situation represents a healthy mode of adjustment, even though the difficulties be great. False ideals represent difficulties badly handled, and are more diagnostic of the presence of difficulties, since the self-deception they involve would scarcely be gratuitous. No phase of the inquiry demands more thorough

not alone, and some charming friend had consented to go along life's path with him,—and the friend was none other than that cloak, with thick wadding and a strong lining incapable of wearing out. He became more lively, and his character even became firmer, like that of a man who has made up his mind, and set himself a goal. From his face and gait, doubt and indecision—in short, all hesitating and wavering traits—disappeared of themselves. Fire gleamed in his eyes: occasionally the boldest and most daring ideas flitted through his mind; why not, in fact, have marten fur on the collar? . . .

¹ The 'biogenetic psychoses.'

knowledge of the person, nor more penetrating judgment in weighting the obtainable information.

The concrete lesson for mental hygiene is to avoid all mechanisms of idealization that are not readily and directly convertible into action; in every case to be most careful that the things idealized are things really wished for, and not to form ideals in opposition to underlying tendencies of the personality, or allow them to be formed in others for whose mental welfare we are responsible.

CONCLUSION

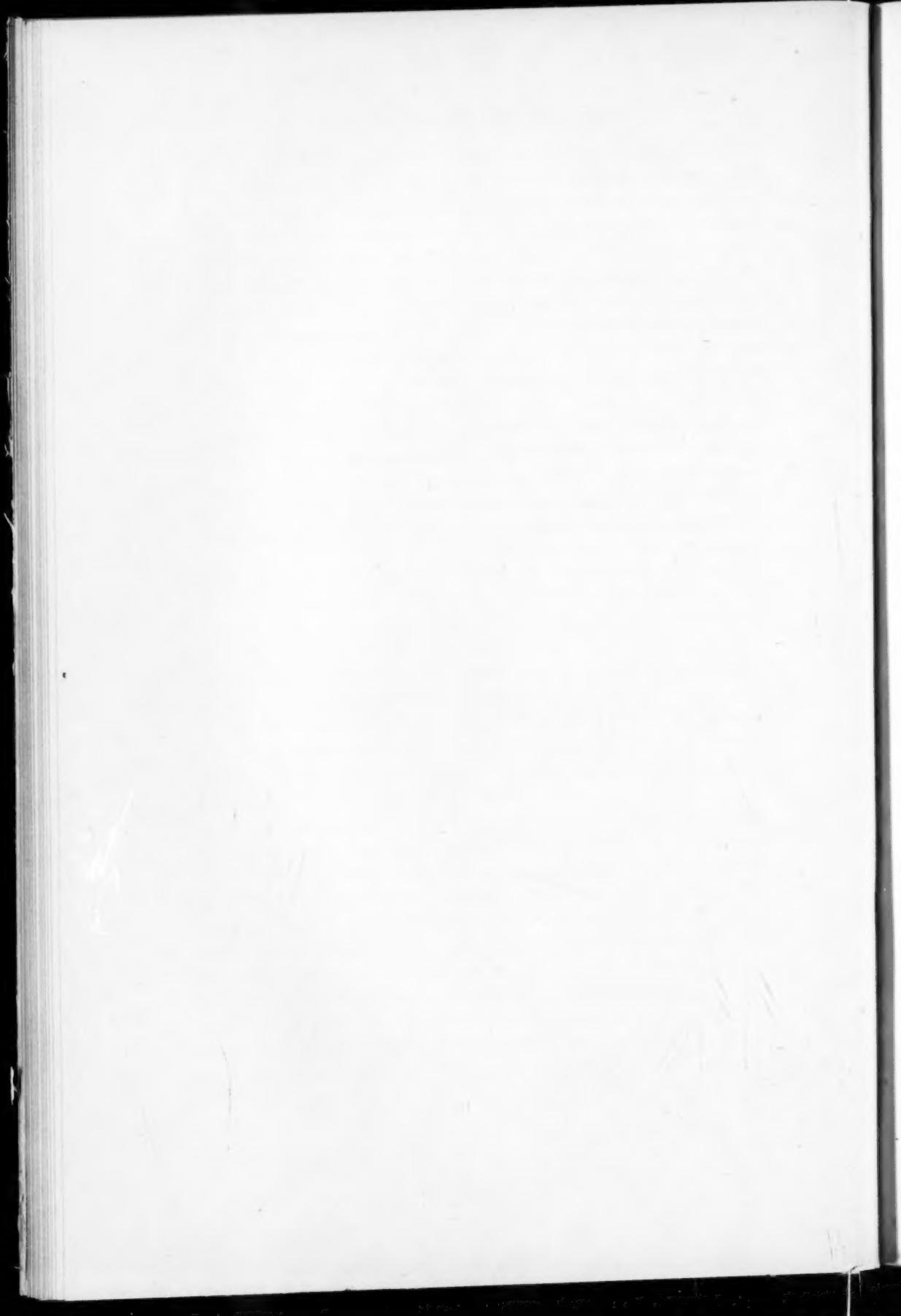
Considering in respect to mental balance the personalities with which one's acquaintance is sufficient, there is observed in the first instance a reaction type not greatly burdened by internal difficulties, the makeup not harboring such traits as predispose towards them. Such personalities are comparable to ships well provided with proper charts and other equipment, which hold an accurate course through deep and open waters, disturbed only by such storms of fortune as may cross their path from without. Other personalities are hampered in their reactions by specifically unfavorable features of temperament, as hypersensibility, self-depreciation, ambition beyond capacity; but in whom clear vision and frank recognition of the difficulties provides a compensation adequate to preserving the individual's essential adaptations to life. Such is the case of a ship whose course is laid among many rocks and whirlpools, but which, provided with good compass, accurate charts and other instruments of navigation, may well come through safely, if painfully and with hardship. These types grade into still others in whom the unfavorable trends are reacted to in ways harmful to the personality, as when hypersensibility breeds ideas of unfairness, self-depreciation breeds lack of effort, and imagination (or drugs!) are called upon for what is unattainable in reality. This is to sail by false charts, with undependable steering gear, and with compass out of adjustment. What wonder if such a vessel grounds over the shoals of failure or blunders upon the reefs of psychosis?

The personality in its present conception denotes an *ensemble* of characters ordinarily regarded as much dominated by hereditary influence. There is no reason to discount the supposition that mentally healthy parents endow their children with a corresponding capacity and tendency for mental right-living; and that parents of psychopathic constitution may transmit to their offspring the same possibilities for mental upset as were manifest in themselves. Under such circumstances the individual starts out with a constitutional tendency to bad mental habits that would in any event vastly increase the educational problem. But in the first case the child grows up in a healthy domestic atmosphere, while in the second a bad heredity plays directly into the hands of a bad environment, providing a neurotic *milieu* in which undisciplined plays of imagination and emotion, with other harmful mental tendencies, find ready opportunity for their rankest growth. Under such circumstances the psychopathic personality probably owes its development quite as much to modifiable conditions of early childhood as to heredity or original nature. Extreme import therefore attaches to the minute study of all such early environmental factors (only child!) and tendencies as lead immediately towards unfavorable habits of mind.

We deal here with the description of finished products, but are at once led back to the inquiry of what were the specific conditions, hereditary, infantile, or educational, that caused such mental tendencies to develop.

What unfavorable environment causes, correct external influences can prevent. The individual must be decisively turned from the establishment of various often obscure means of subjective gratification, and educated to a rigid dependence upon action in the external world. Every effort must be made to ensure adequate sense for objective, social values in life, and aspirations in accordance with them; that mistakes, failures, and deficiencies are faced squarely, without self-deceptive subterfuge, and that moral energy is not dissipated in the maintenance of perverted standards of conduct. Thus shall we provide the less favored vessel with proper charts,

and a rightly adjusted compass. It may still remain a frequent experience that, through no fault of intellectual endowment, certain personalities are constitutionally unfitted to shape their own mental or social reactions, all attempts at independent activity involving them in direct conflict with external conditions, or in affective complications which they can never adjust in conformity with social order. "*Video meliora proboque, deteriora sequor.*" These vessels cannot keep the course under their own power, and require special surroundings whose situations are artificially simplified to meet their capacity. The management of psychogenesis for the most efficient balance of mental faculties and surrounding conditions is a question of transcending value for breadth of normal and pathological application, and in the vital character of the personal and social issues dependent upon it. The constructive problem of psychology is mental adaptation.





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